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River-front View of the Dow Chemical Company, From an Oil Painting by A. H. K. Hammond

Contents for February, 1930

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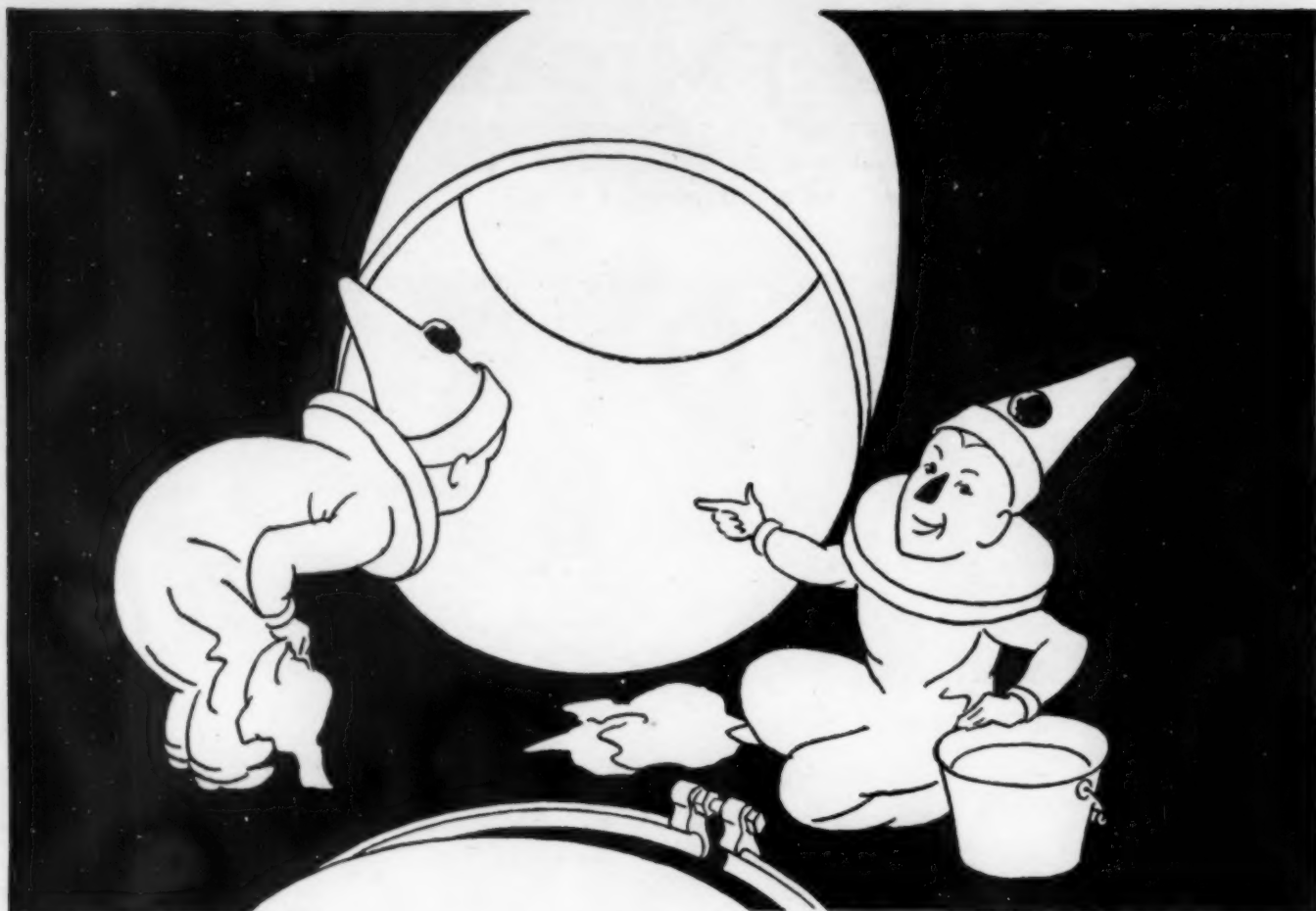
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CHEMICAL & METALLURGICAL ENGINEERING

VOLUME THIRTY-SEVEN

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FEBRUARY, 1930

S. D. KIRKPATRICK, *Editor*

Alcohol Fights Its Battles

ONLY an industry inherently strong and firmly intrenched in our economic and business structure could have withstood the recent attacks that, from nearly every direction, have centered on the producers of industrial alcohol. Facing threats of a drastic tariff on its principal raw material, ground between the prohibition millstones of wet and dry fanatics, a target for competition from substitutes and itself a part of a rapidly changing technology, the alcohol industry has had anything but a happy time. Yet in the face of all of these disturbing elements, the industry has advanced steadily—stabilizing its production, expanding its markets and strengthening its position in relation to governmental control.

FORTUNATELY, the tempest stirred up by the ill-advised efforts to put a prohibitive tariff on blackstrap molasses now appears to have subsided. Determined opposition on the part of both the alcohol producing and consuming industries convinced a sufficient majority in the Senate that a high duty on this raw material would merely force the industry ahead to a synthetic process rather than force it back to the use of grain. It was shown that the proposed tax of 8 cents per gallon would have increased the cost of industrial alcohol by more than \$22,000,000. This would have been reflected in the costs of a multitude of articles used by practically every citizen of the country.

LESS EASILY QUIETED, however, is the ominous storm that again draws industrial alcohol into the center of the prohibition controversy. The wets renew their charge that the Government is intent on killing its citizens with "poisoned" alcohol. The dries still hold that denatured alcohol

is the principal source of illegal beverages despite the fact that the present control of production has made the diversion of industrial alcohol practically impossible. Commissioner Doran has shown conclusively that of the 110,000,000 gal. produced last year, not more than 2 or 3 per cent could have passed into the hands of the bootleggers.

NOR IS ALL QUIET in the field of technology. The threat of synthetic alcohol from ethylene is occasionally heard, although it is apparent that any dominating development is still in the somewhat distant future. Of more immediate concern is the competition from synthetic methanol. Already favored on a price basis, the newer material is asking for an important share of the industrial alcohol business. The measure of its success in this field will ultimately influence all prices—even that of molasses, which is the factor of most concern to many of our American companies. A favorable effect would be to force ethyl alcohol into more profitable uses, such as the direct production of acetic acid, ethyl acetate or acetic anhydride. Already, there is evidence that in this direction lies an attractive opportunity for the alcohol industry.

ENOUGH, perhaps, has been cited here to show that the schooling in adversity which the industry has received in recent years will stand it in good stead in the development to come. Guided by intelligent management, strengthened by a resourceful technology, the alcohol industry will give a satisfactory account of itself whether in the halls of Congress, the government departments, or in the highly competitive fields of technical development.



EDITORIALS



FEBRUARY, 1930

Penalties of Politics

CHEMICALS come first in the tariff and, as usual, this schedule has had to bear the brunt of the attack of the opposing forces. New antagonists as well as new defenders of chemical industry have appeared in the Senate ranks. As the smoke cleared away it was apparent that while a few victories had been recorded there also were a great many serious losses. Shortly, the badly patched-up result will go to conference for further negotiation. Sometime, presumably soon, the conference measure will be enacted—a relief from the present uncertainty even if it does not materially help those chemical industries that have prayed for tariff relief from increasingly severe competition.

Promoting Economic Stability in Chemical Engineering Industries

FUTURE GROWTH and expansion of chemical producing and consuming industries, as well as their economic stability, will depend to a considerable extent upon well-planned, co-operative effort. Despite the fact that most of these industries have strong and efficient national trade associations, there is real need for regional organizations that can work intimately with local industries in the solution of their common problems. To bridge this gap between national and local interests is, therefore, a logical step in the direction of industrial progress.

The Business Week has suggested that present industrial conditions make this an opportune time for the promotion in each of the natural economic divisions of the country of a permanent organization on the plan of the regional council now in operation in New England. The organization of the New England Council is indeed simple and elastic and could easily be modified to meet local conditions in other parts of the country. Governors of the states are sponsors and active members, and each state is represented on every standing committee. Quarterly meetings of the council are held in each state in turn. In this particular instance financial support is given voluntarily and is increasingly easy to obtain as the value of the organization is demonstrated by actual

results. Some of the accomplishments already noted in New England are a stimulation of industry through research, the improvement of transportation facilities, and better power distribution. Less tangible, but perhaps more important, is the new spirit of unity and confidence that has displaced the attitude of discouragement and despair which once handicapped the future of this important economic area.

Regional councils would assist the chemical engineering industries in their distribution as well as production problems. Well-established centers for certain of our industries have already felt the effect of the industrial migration brought on by excessive costs of transporting raw materials and manufactured products, competitive bidding for labor and the other disadvantages of a congested industrial locality. It is well known that the majority of the plants producing chemicals are located in the states of New York, Pennsylvania and New Jersey, while there are very few in New England, the South and the Southwest. On the other hand, New England, the South and the Southwest are important markets for chemicals. Furthermore, while the raw materials for the chemical industries are distributed over the entire country, they are found most abundantly in the very districts in which there are now but few industries producing chemicals.

Future development of the chemical engineering industries must be based on a more reasonable relation to these new industrial markets and their raw material resources if the consumer is to be served most efficiently. Unbiased surveys of the available natural resources, of the supply of labor, of power, of water and of transportation facilities, would do away with guesswork and put the selection of a place in which to locate a plant on a more scientific basis. The regional council would foster uniform laws governing commerce, wipe out restrictive local barriers to trade, improve transportation, and otherwise promote the common interests of the territory.

Chem. & Met., therefore, joins with *The Business Week* in urging that the leaders of the process industries contribute their support to this program of regional councils. Active participation in such a movement will do much to speed up those economic forces that are already at work but are now handicapped through the lack of machinery for co-operative effort.

Help Remove These Hazards

LAST MAY the entire country was profoundly shocked by the reports of the Cleveland Clinic disaster with its toll of 123 lives. Although this terrible lesson undoubtedly has impressed some degree of safety-consciousness upon the layman users of dangerous materials, serious accidents, particularly attributable to nitrocellulose film, still occur. Since the Cleveland disaster, at least five nitrocellulose fires in various parts of the country have resulted in much property damage and in many casualties, some of which were fatal.

It is not to be expected that dangerous conditions in the hands of the non-technical can be eradicated immediately. It is frequently a fact that the condition is not recognized as hazardous until it is forcibly brought to the attention of the user through a fire or explosion, or after a visit from the fire insurance inspector or a city fire warden. A case of this type was uncovered recently in

Cleveland, this time before any damage had been done. Again an offender, the Cleveland Clinic had a plant in operation in the basement of its hospital building, engaged in making nitrous oxide from ammonium nitrate. As the potential explosion hazard, doubly dangerous in a hospital, had not been recognized by the clinic authorities, the city's action in closing the plant came as a complete surprise.

If hazards such as these were only occasional, there would be no great cause for concern. But in view of the frequency with which dangerous operations break loose in the hands of the unskilled, greater vigilance on the part of city and insurance inspectors is much to be desired. If chemical engineers, knowing of the existence of hazardous conditions, should bring them to the attention of the proper authorities, they would be rendering a valuable service to their communities.

Executive Direction for Chemical Engineering

CARRYING OUT the mandate of the membership, the council of the American Institute of Chemical Engineers has appointed Frederic J. Le Maistre, of Philadelphia, to the important post of executive secretary. He brings to that position the background of a well-rounded career in chemical engineering and industry. He has been active not only in the profession but has contributed greatly to the civic and cultural life of his community.

A member of the Institute since 1910, Mr. Le Maistre has intimate knowledge of the early history, purposes, and policies of that organization. More important, he looks to the future of chemical engineering and to the part the Institute can play in directing the profession. The science and its application must be carried into new fields. Its present position must be strengthened and consolidated in older industries in which it has advanced but slowly. Finally, chemical engineering must win the recognition and respect of the general public.

In all of these directions the guiding hand of the experienced executive can be of invaluable help. *Chem. & Met.* extends hearty congratulations to Mr. Le Maistre, to the Institute and to the profession.

A Parable of Parallel Lives

IN THE SPECIAL recognition that the Perkin and James Douglas medals accord to the achievements of Herbert H. Dow and John V. N. Dorr, the most immediately appealing aspect probably will be the ever-romantic picture of men who have pulled themselves up, in effect, by their own bootstraps. Both cases represent a slight variation on this theme, because neither appears to have suffered the customary adolescent privations in comfort and education. Yet this discrepancy may perhaps add to their renown, since the popular path of the successful man is wont to proceed from poverty. Either way, both Dow and Dorr had soon afterward to contend with adversity, and—this much at least in strict accord with tradition—attained to their eventful stride by overcoming it.

Of course, a feature that segregates their path at once from the beaten one of eminence is its origin in severely scientific regions; another, its progress along a ridge of

individual technical conquest; and a final one, its culmination in an industrial peak resting entirely and logically on its technical antecedents. Two conspicuously healthy companies now attest to this; and both still embody the individuals who were their only members in the 90's.

But back in the early days, young Dorr, trained as an engineer, applied his ingenuity to metallurgical and chemical processes; young Dow, a chemist, brought his resources to bear on the engineering difficulties of producing bromine. And evolving along these principles, the mature Dorr now deals with complete chemical engineering processes—and hence products—while the mature Dow develops unforeseen chemical products, and necessarily engineering processes. Could two men have been more happily selected for distinction at this same time? For the gesture would seem to come as a tribute not only to their high esteem as men but also quite as appropriately to their personification of the two converging factors that gave us the concept of chemical engineering.

War of Words in the Plastics Industry

IN SPITE of the commercial evidence that plastics have overcome the disorders of juvenility, it appears that the industry and trade are still at loggerheads on a generic designation for the product. The intangible value of the various trade names is conceded and jealously guarded; nevertheless, what do they all represent? They are all "synthoids," decided a recent prize award. But on grounds of foolishness and non-description this name has found the field unsympathetic and has called forth such counter-inspirations as "rezoid" and "plastoid." While *Chem. & Met.* is little inclined to meddle with merchandising profundities, it is concerned with the nuisance and obscurity that have beclouded even technical descriptiveness. Since the several products are related through their organic nature, their general physical character, and the fact that in some stage or other they are "plastic," it seems the reasonable solution to have a generic name that at least suggests this kinship. It would then include not only all the products from bases of cellulose, phenol, urea, casein and what not, but also their various commercial forms, whether molded, cast, powdered, filled, or laminated.

The subdivisions could then automatically fall into such descriptive modifications as "cellulosic," "resinous," and "condensate." But the name would exclude all unrelated and inorganic materials, which, merely because they are capable of softness, might indicate some closer affinity.

Under the circumstances "plastoid" seems not such a painful group-label after all, while the trade names could flourish under its coverage as prolifically as always. But what is the objection, if inclusively interpreted, to that most venerable and least "manufactured" name of them all, "plastics"?



Lacquer Enamel Production *Simplified*

By JAMES A. LEE
Assistant Editor
Chem. & Met.



IN THE SPRING of 1910, Emile C. de Stubner, a young Swiss chemical engineer, having completed his studies under Le Chatelier and Jungfleisch, successor to Berthelot, came to America, where he has devoted his talents to a number of problems predominantly allied with varnishes and pigments. One of his first accomplishments after arriving in his adopted country was the development of a more scientific method for the production of varnishes. His was the first installation of super-heated steam for the heating of the kettles: a change which, of course, was strongly opposed by the old-time makers who believed that varnish could be made only over open fires. The innovations were then used in the plant of the de Stubner Process Company, in Montreal, for the manufacture of electrical insulation varnishes.

During the World War the Columbia Graphophone Company was not able to obtain a sufficient supply of montan wax, a raw material that it had been accustomed to import from Germany and that had been the principal constituent of the compound from which the "master

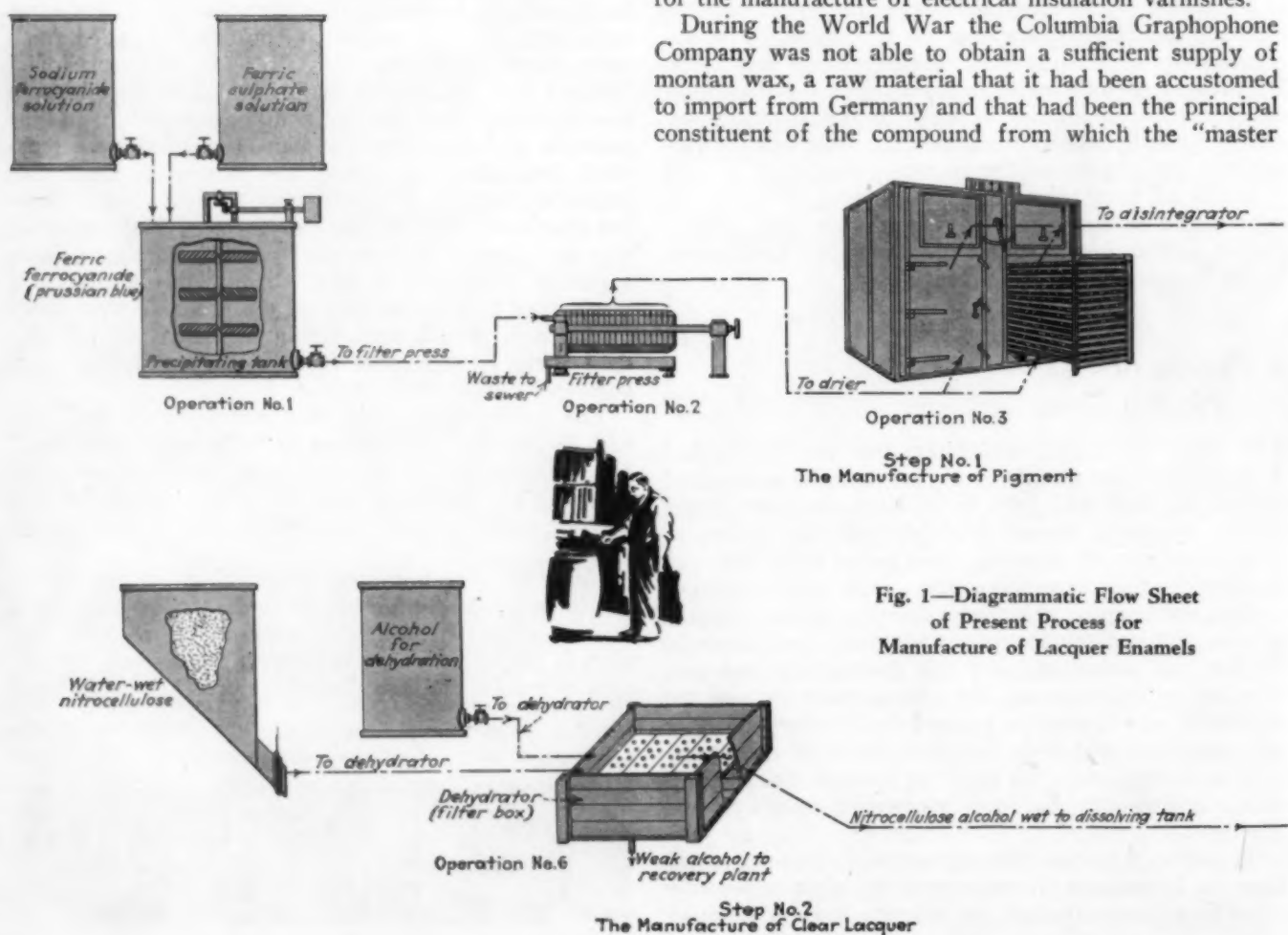


Fig. 1—Diagrammatic Flow Sheet
of Present Process for
Manufacture of Lacquer Enamels

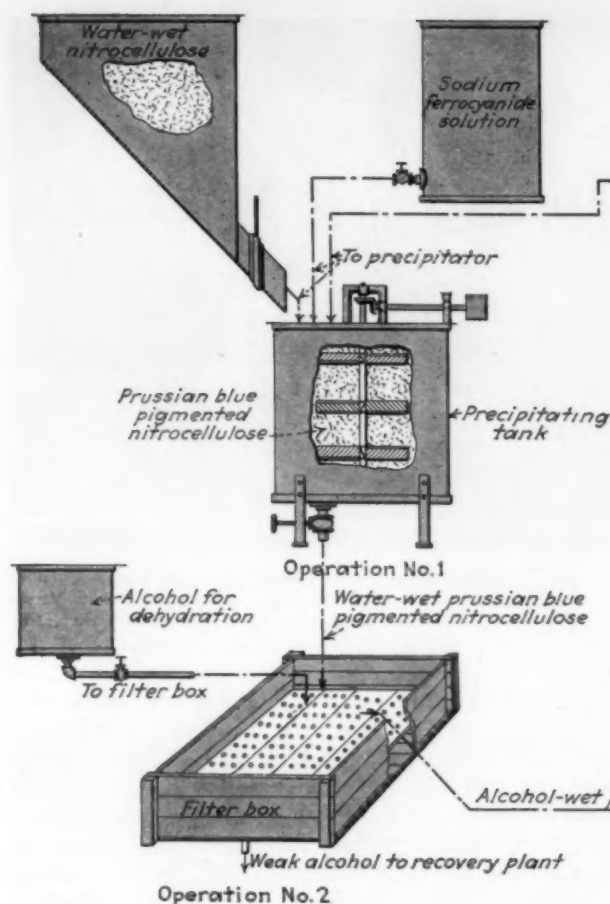


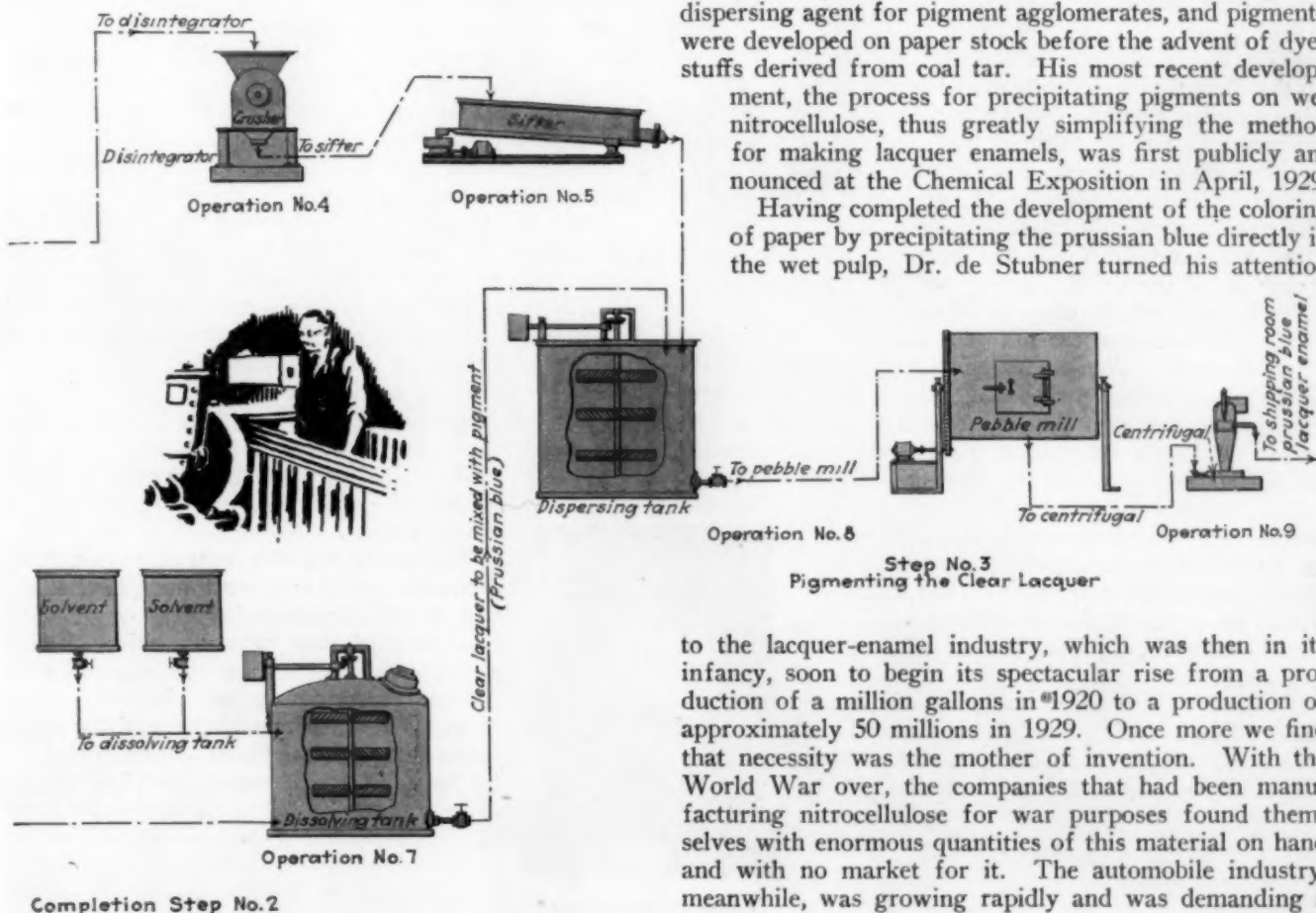
Fig. 2—Flow Sheet of the de Stubner Process

records" were made. About that time Dr. de Stubner came to New York as a consulting engineer, and the company secured his services to develop a substitute for this bituminous wax. He subsequently developed a shellac and resin thermoplastic for making commercial records—which, of course, was related to his chosen field of varnishes.

It was during this period that de Stubner became acquainted with Philip T. Dodge, whose name is so inseparably connected with the development of the Canadian and American newsprint industries. Several years later he was confronted by the latter with the problem of coloring paper, an emergency war measure when these countries were temporarily cut off from a supply of suitable dyestuffs. His visits as consulting engineer to the mills of the International Paper Company really planted the seed for his process of pigment dispersion in lacquer

enamels. Dr. de Stubner recognized that the fibers of cellulose presented a most efficient deflocculating and dispersing agent for pigment agglomerates, and pigments were developed on paper stock before the advent of dyestuffs derived from coal tar. His most recent development, the process for precipitating pigments on wet nitrocellulose, thus greatly simplifying the method for making lacquer enamels, was first publicly announced at the Chemical Exposition in April, 1929.

Having completed the development of the coloring of paper by precipitating the prussian blue directly in the wet pulp, Dr. de Stubner turned his attention



to the lacquer-enamel industry, which was then in its infancy, soon to begin its spectacular rise from a production of a million gallons in 1920 to a production of approximately 50 millions in 1929. Once more we find that necessity was the mother of invention. With the World War over, the companies that had been manufacturing nitrocellulose for war purposes found themselves with enormous quantities of this material on hand and with no market for it. The automobile industry, meanwhile, was growing rapidly and was demanding a

new body finish that would lessen the time of nine days then required for painting. Due to these two very important economic factors the lacquer-enamel industry owes its start and rapid advance.

However, there were numerous difficulties that had to be overcome before the successful development of the present method, which consists of three major divisions: the manufacture of pigment, the manufacture of clear lacquer, and the pigmentation of the clear lacquer. This is a long and difficult procedure, due to the time-consuming decantation operation, which is a matter of days in large-scale production and requires large tank capacities to produce as much as one ton in 24 hr. It is due further to the difficulties in grinding the pigment, which requires not only several days after it has been made but also further grinding later, to get it properly dispersed in the lacquer.

A diagrammatic flow sheet of the method in general use at present for the production of lacquer enamels is given in Fig. 1.

When Dr. de Stubner became interested in and tackled the problem of manufacturing lacquer enamels, he found that upon perfect dispersion of the pigment, to a large extent, depends the quality of the lacquer enamel. He found that pigments offer considerable resistance to dispersion in viscous fluids, such as oils, varnishes, and cellulose solutions, and that it was not uncommon to grind for more than 100 hr. to obtain proper dispersion of carbon black, prussian blue, brewster green and toluidine red.

Then he recalled how he had been able to color cellulose in the plant of the International Paper Company by precipitating the pigment directly in the cellulose. The idea occurred to Dr. de Stubner that, since it was possible to precipitate a pigment directly in cellulose, it probably would be possible likewise to precipitate a pigment in the closely physically related product, nitrocellulose, and thus eliminate both of the grinding operations, the grinding of the dried pigment and the grinding in the clear lacquer for the purpose of dispersion.

He determined in the fall of 1924 to test out his idea experimentally. At first his efforts were confined to the study of various manufacturing effects upon the size of the precipitated particles of chrome yellow, since it is one of the simplest pigments. He found that the presence of deflocculents doubled the number of particles per gram—in other words, gave greater dispersion. Exhaustive tests also were made to determine the influences of concentration, temperature, and neutrality of the solution. Later he extended his investigations to include blanc fixe, prussian blue and other pigments.

The exhaustive preliminary investigations led to the conclusion that it would indeed be practical to precipitate the pigment in the presence of the water-wet nitrocellulose.



Fig. 2—Filter Boxes and Alcohol Storage Tanks Used in Production of Lacquer Enamel. This and Other Views Are in the Plant of Robinson, Butler & Hemingway, Inc.

The practicability of the fundamental idea had been demonstrated, and the remaining problems included the determination by experimentation of the most suitable operating conditions, and the designing of large-scale equipment suitable for the production of lacquer enamels on a commercial scale by this method.

An extensive research program was carried out to determine the proper operating conditions. Of considerable importance was the knowledge of the optimum dilutions of the two water solutions of the salts, sodium ferrocyanide and ferric sulphate, used for precipitating the pigment, prussian blue. This was required in order to get: (1) the greatest amount of dispersion; (2) a liquid of a viscosity that would permit it to flow easily through a valve in the bottom of the precipitator; and (3) a mass that could be filtered without great difficulty. The problem of dehydration was easily solved, and the solvents, diluents and plasticizers used in the present lacquer enamels were, of course, suitable in the new ones.

With the proper operating conditions determined by experimentation, the remaining problem was the design of the commercial scale equipment. Several years previously, de Stubner had made the acquaintance of Frank Hemingway, whose commercial prestige in the domestic chemical and pigment industries impelled the former to turn to him when he required a plant in which to develop and test out large-scale equipment. Hemingway at once recognized the economic value of the new process and made his plant, with its equipment and personnel, in Bound Brook, N. J., available to the inventor.

The equipment also went through a development stage of trial with much of the grief that usually accompanies such work. Several months' time was spent in selecting, developing, and testing the apparatus required to carry out the manufacturing operations. The filtering and the washing of the water-wet pigmented nitrocellulose proved to be the most troublesome operation because



Emile C. de Stubner

of the nature of the wet material, which tends to clog up the holes in the filters. Another problem in filtering was, what material of construction should be used to prevent contamination of the product, and another, what design. In the course of the development, trouble was encountered from corrosion in the construction of filter boxes, and it was not until after many designs and metals had been tried that a satisfactory box was constructed of wood, lined with Monel metal. The result is shown in Fig. 3 and measures 8 ft. in length, 3 ft. in width and 8 in. in depth. It is equipped with a light weight cover, a skeleton wooden frame covered with cloth, which serves to retard the evaporation of the alcohol during the dehydration operation.

After the filter box was developed, the design of the other pieces of equipment was relatively very simple. Wooden tanks, equipped with electrically driven stirring devices, were designed for storing the solutions of salts for the precipitating tanks. Day Imperial mixers were found to be suitable for dissolving the nitrocellulose fibers and for adding the remaining constituents of the lacquer enamel.

The principal features of the completed process can

into one of the lower tanks, to be seen in Fig. 4, the water is added and the stirring is begun. Water solutions of sodium ferrocyanide and ferric sulphate are prepared in separate wooden storage tanks conveniently located above the larger precipitating tanks. The required quantities of each salt solution are run by gravity into the precipitating tank and the prussian blue precipitated on the water-wet nitrocellulose fibers in a very finely dispersed condition.

The resulting product, in a pulpy state, is drawn off through a valve in the bottom of the tank and transferred to the filter box. The capacity of the filter varies with the different pigments but is approximately 400 lb. of material. The boxes are placed in rows on metal benches 32 in. high, conveniently located in respect to the alcohol-storage tanks. A pipe line from the tank extends along the upper edge of the bench and supplies the alcohol used for dehydrating the water-wet pigmented nitrocellulose; a meter on each box accurately measures the alcohol. When the water-wet nitrocellulose is placed in the filter the cover is put on and most of the water is first allowed to drain off, the remainder being removed then by four applications of alcohol. The dehydration requires 24 hr.

The dehydrated mass is transferred to the disperser, where it is turned into lacquer enamel, by dissolving the nitrocellulose fibers in ethyl acetate and adding to this the remaining lacquer ingredients (plasticizers and resins) and diluents.

A reduction in the number of chief operations in lacquer-enamel manufacture from nine to three has been made possible by the new technology. In addition to this simplicity, the finished lacquer enamels reflect the original hues and brilliancy of the colors, for at no time have the pigments been exposed to the contaminating atmosphere of the drying over. It goes without emphasis, that in such a typical chemical engineering achievement, close control and continued systematic research are evident throughout.

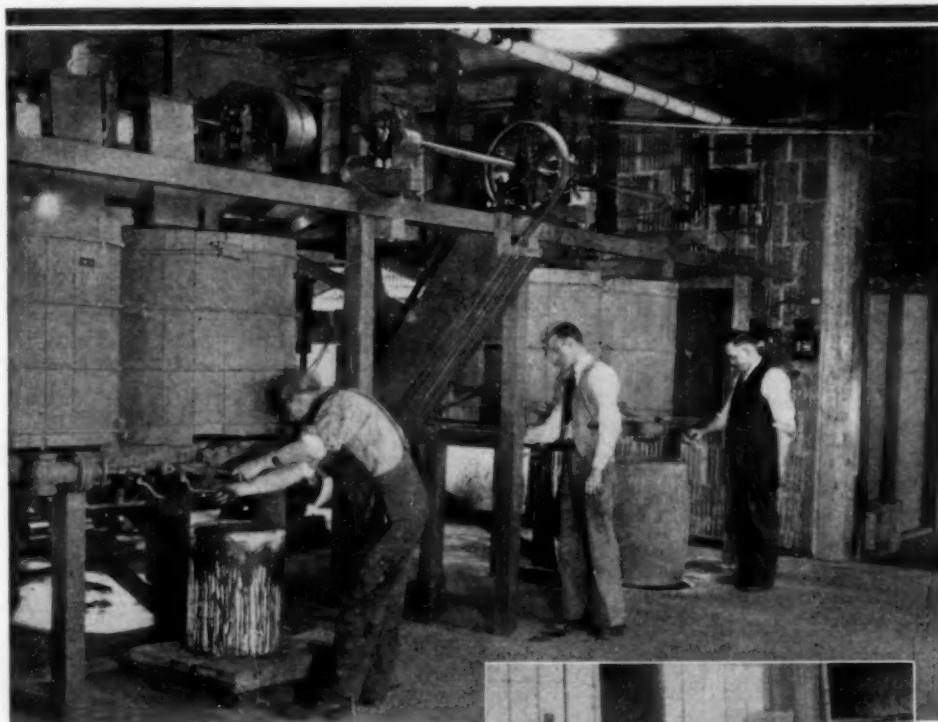


Fig. 4—Precipitating Tanks With the Salt Solution Tanks Above

be illustrated best by a description of the method used for manufacturing prussian blue at the plant of Robinson, Butler & Hemingway, Inc., at Bound Brook. The process used in this plant is depicted in the diagrammatic flow sheet in Fig. 2, which illustrates the three major operations in the manufacture of the lacquer enamel, the pigment being precipitated in the very first step. The nitrocellulose, received water wet, is charged

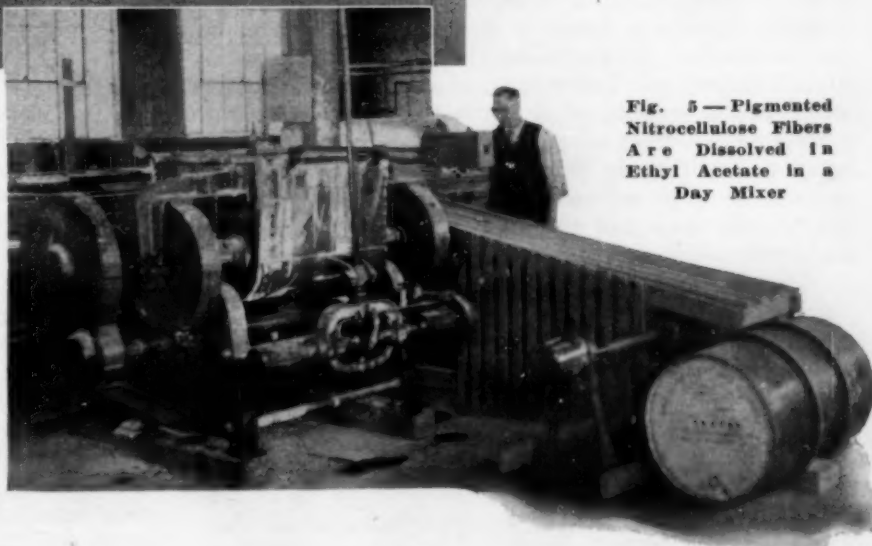


Fig. 5—Pigmented Nitrocellulose Fibers Are Dissolved in Ethyl Acetate in a Day Mixer

Assisting the

Paper Industry

In Solving Its Problems



Main Building, Forest Products Laboratory, Madison, Wis.

By C. C. HERITAGE and C. E. CURRAN

Formerly in Charge *Acting in Charge*
Section of Pulp and Paper, Forest Products Laboratory,
Madison, Wis.

ONE OF the important activities of the Forest Products Laboratory is in the general field of pulp and paper research. This laboratory as a whole functions under the direction of the Forest Service toward the goal of fuller and more efficient utilization of the forest crops of the United States. The Forest Service is charged with the management responsibility for the national forests and approximately one-third of the standing timber of sawmill size in the United States is located in these forest areas. There is, therefore, ample justification for the maintenance of a body of technical men constantly engaged in studies of forest utilization, particularly since a forest is an agricultural crop to be harvested when ripe and to be grown with full expectation of harvest and full utilization of the harvested material for the greatest good to the greatest number.

This presentation of some of the current pulp and paper research at the Forest Products Laboratory will perhaps be made of more general interest by dealing briefly with several of the more important lines, rather than with some one project in detail. There are four products or materials involved, namely paper, stuff, (the term applied to paper pulp when it is intermediate between the raw pulp stage and the finished paper), pulp, and wood, each identified and evaluated by its properties. Each adjacent pair of these materials is related by the operating or process variables that establish the conditions of conversion of one to the other. The requirements of the final product as consumed constitute the

foundation upon which each successive field of work must be built.

On the basis of these fields of work, a clear picture can be had of the major research objectives. These are classified as follows:

1. Fundamental work
 - A. Improved methods for evaluating
 - a. Paper products relative to their use.
 - b. Pulps and stuffs relative to paper products.
 - c. Pulp woods relative to pulps.
 - d. Land and forest relative to pulpwood.
 - B. Increased knowledge of the effects of
 - a. Machine variables.
 - b. Fiber processing variables.
 - c. Pulping variables.
 - d. Land and forest variables.
2. Applied work
 - Improved and increased utilization of
 - A. Specific species.
 - B. Pulpwood at the mill.
 - C. Waste.

This distinction between fundamental and applied work is a basic one, because for successful fundamental work, careful, precise, and thorough scientific experimentation must be had regardless of other considerations, whereas for successful applied work the specific objectives are to be attained directly and promptly, with the utilization of whatever fundamental work or empirical knowledge may be available. As regards fundamental objectives, the problem is, first, to provide satis-

Presented before the Asheville meeting of the American Institute of Chemical Engineers, Dec. 2-4, 1929.

factory evaluating tools for the four materials previously mentioned and, second, to employ these tools to indicate the optimum process conditions for the desired effects.

With the classification above in mind, current work will be discussed under three headings: improved methods for evaluation, increased knowledge of the effects of the process variables, and applied work.

It is obvious that the continued existence of any industry depends in the last analysis on the capacity of the finished product to meet its requirements in use. These requirements always are translatable into chemical and physical attributes, which in turn may or may not be capable of numerical determination, depending on the state of technical knowledge relative to them. It is generally conceded that the evaluating methods available for paper, and also for stuff, pulp, and wood, leave much to be desired.

A study has been initiated, partly through the establishment of a fellowship at the laboratory by the American Paper and Pulp Association, of the relations existing between the physical properties of a sheet of paper, the structure of the sheet, and the properties of the fibers composing the structure. From another angle it is hoped to evaluate the fibrous materials of which a sheet is made through knowledge of the effects of the structural variables on the properties of the sheet itself, as experimentally determined.

In attacking this study a working hypothesis was evolved by considering a sheet of paper to be essentially analogous structurally to many of the other so-called engineering materials; that is, it was thought to consist of solid elements and voids, the solids (fibers) of the paper being arranged relatively to one another in a wide variety of ways. Thus any property of the sheet itself, of given test-piece dimensions, must be derived from some corresponding property or group of properties of the fibers in the sheet as modified by the structure of

the sheet and the actual dimensions of the test piece. Sheet structure has at least two major attributes, namely, volumetric composition and fiber arrangement. Therefore the test piece or sheet property factored for actual test-piece dimensions is some function of the volumetric composition, the fiber arrangement, and the fiber properties.

To test this hypothesis in a preliminary way, certain data on handsheets, reported in the literature (E. P. Cameron, *Pulp & Paper Magazine of Canada*, Feb. 1, 1923), were analyzed. These data include load in tension at rupture, basis weight (weight of a given number of sheets of paper of given dimensions), and thickness. The fiber employed throughout was the same. The handsheets were produced in a considerable variety of basis weights and solid-volume fractions. If the hypothesis has any basis in fact, it should be possible to work back

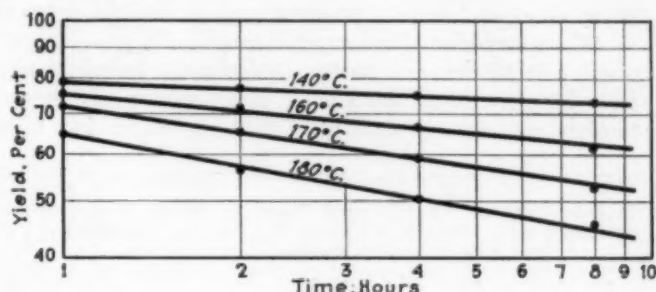
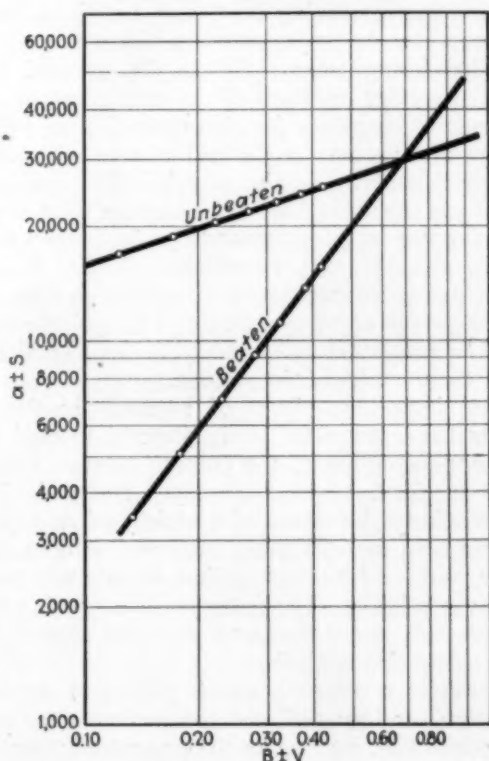


Fig. 2—Hydrolysis of Spruce With Sodium Hydroxide; in an Experimental Digester; the Effect of Temperature on Yield in Relation to Time of Digestion

Fig. 1—Logarithmic Relation Between $a \pm S$ and $B \pm V$ for Bleached Sulphite in Bursting; Curve A, Unbeaten; Curve B, Beaten



from the test-piece strength and arrive at one figure, approximately constant, which is representative of those fiber properties that result in the existence of strength in tension when the fibers are felted into sheets of various structures. Table I indicates what success was had in this direction. Structural strength in tension at rupture is expressed, as usual, in terms of pounds per square inch of area ruptured. Solid-volume fraction is expressed in a simpler term, "apparent density," which is ream weight per "point" or thousandth of an inch of thickness. It was found by trial that, for any given ream weight, the structural strength in tension is roughly proportional to the square of the apparent density. Considering that the constant of proportionality, F , is dependent upon the other element of structure—namely, fiber arrangement—and assuming that the attribute designated as basis weight is some measure of fiber arrangement, it was found by trial that the constant referred to, F , is roughly inversely proportional to the cube root of the ream weight. This second proportionality constant, K , may be considered to measure the attributes of the fibers themselves that result in the manifestation of strength in tension, when the fibers are felted into a sheet of any weight and any corresponding thickness. The general expression becomes:

$$T = \frac{KW^{5/3}}{C}$$

where T is load at rupture in tension, W is ream weight, C is thickness, and K is "potential" fiber strength in tension, dependent in numerical value upon the units chosen for T , W and C .

It appeared that this approximate analysis was of sufficient value to justify more careful investigation of

the general relationship between structural strength and percentage of solids by volume, or solid-volume fraction. Although the work has not proceeded far enough to be certain of the relationship reference to Fig. 1, which is a logarithmic graph of $(a \pm S)$ plotted on $(B \pm V)$ where S is structural strength in bursting and V is solid volume fraction, shows the function to be of the general type

$$S + a = M (V + B)^n$$

It appears from the study thus far that the value of n has the greatest significance in relation to the degree of beating or hydration of the pulp.

Relative to the evaluation of pulps, there are many properties known to be of importance that thus far have not been susceptible of numerical treatment. Of these, work has been centered upon the determination of particle size. The first pulps to be investigated have been the coarsest ones found in commercial practice; namely, those employed for the manufacture of insulating board. A laboratory-size diaphragm-actuated flat plate screen similar in all respects to the design used in mill operation has been equipped with four screen plates containing respectively slots of 0.020 in., 0.015 in., 0.012

Table I—Sheet and Fiber Strength Properties Derived from Cameron's Data on Tensile Strength at Various Wet-Pressing Pressures and Basis Weights

1	2	3	4	5	6	7	8	9	
Approximate Basis Weight, Pounds W	Sheet Strength, Lb. per 1 Ft. Width T	Sheet Thickness, Inch C	Structural Strength $\frac{T}{C \times 12}$	Lb. per Sq. In. S	Apparent Density $\frac{W}{C \times 12}$	Lb. per "Point" D	Average of Col. 6 Values Formation Strength F	Fiber Strength $\frac{FV}{W}$	Wet-pressing Pressure, Lb. per Sq. In.
45	1.3	0.0080	13.5	5.4	0.46	0.51	1.82	None	
	2.1	.0046	38	9.8	.40			200	
	3.0	.0045	36	10.4	.52			400	
	3.1	.0044	39	10.5	.54			600	
	3.1	.004	64	11.0	.53			800	
	3.2	.004	67	11.0	.55			1000	
3.4	.004	71	11.1	.57	1400				
74	2.0	.014	12	5.3	.43	0.47	1.97	None	
	4.4	.007	32	10.6	.46			200	
	4.7	.0065	60	11.1	.48			400	
	5.0	.0063	66	11.7	.48			600	
	5.4	.0062	72	12.0	.50			800	
	4.7	.006	65	12.3	.43			1000	
6.2	.006	86	12.9	.52	1400				
94	2.3	.0175	11	5.3	.39	0.41	1.87	None	
	4.7	.009	44	10.6	.39			200	
	5.2	.0082	53	11.4	.41			400	
	5.7	.0078	61	12.0	.42			600	
	6.0	.0075	67	12.7	.42			800	
	6.0	.0072	70	13.0	.41			1000	
6.5	.0072	76	13.0	.45	1400				
111	2.6	.020	11	5.6	.36	0.37	1.78	None	
	4.0	.010	33	10.6	.30			200	
	5.4	.0095	47	11.8	.34			400	
	6.4	.009	59	12.6	.37			600	
	6.8	.009	63	12.2	.42			800	
	7.2	.0085	71	13.2	.41			1000	
7.2	.0085	71	13.2	.41	1400				
148	2.7	.026	9	5.65	.28	0.30	1.59	None	
	5.0	.014	30	10.6	.27			200	
	5.3	.013	34	11.4	.26			400	
	6.5	.012	45	12.3	.30			600	
	7.3	.0115	53	12.9	.32			800	
	7.7	.011	58	13.5	.32			1000	
	8.3	.011	62	13.6	.33			1400	
Average							1.81		

Table II—Diaphragm Screen Analysis and Coarseness Modulus of Three Commercial Insulating Boards.

Screen Fractions	Percentage of Screen Fraction Board A	Board B	Board C
Retained on 0.020-in. slots.....	7.1	3.8	4.6
Passing through 0.020-in. slots and retained on 0.015-in. slots.....	18.7	11.2	4.6
Passing through 0.015-in. slots and retained on 0.012-in. slots.....	14.1	11.5	25.0
Passing through 0.012-in. slots and retained on 0.008-in. slots.....	18.7	27.1	30.0
Passing through 0.008-in. slots.....	41.5	46.4	36.4
Coarseness modulus.....	1.31	.99	1.12

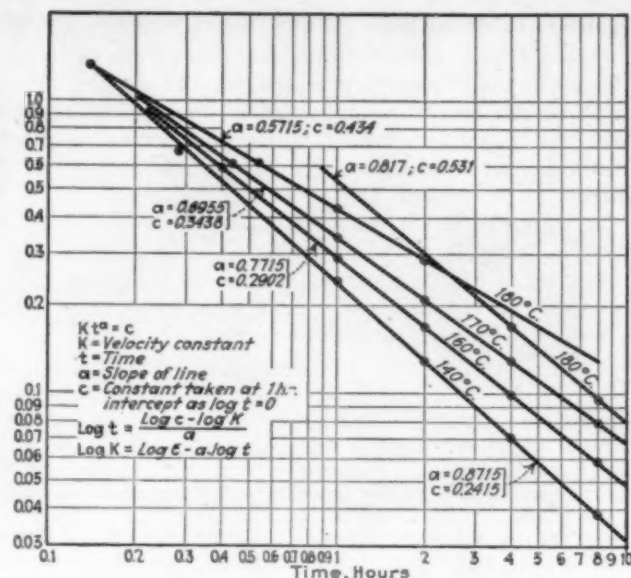


Fig. 3—Hydrolysis of Spruce With Sodium Hydroxide; Effect of Temperature on the Velocity of Pulping Reaction. Chemical Added 20 Per Cent

in., and 0.008 in. width. A sample of pulp is screened successively through each plate, five fractions being obtained. The screen analysis of the pulp as found in several commercial insulating boards is given in Table II. The coarseness modulus is calculated according to Abram's practice in the screen analysis of sands and aggregates, by adding the percentage retained on each plate acting alone and dividing this sum by 100. As the modulus increases the over-all coarseness of the pulp increases. The same technique, employing Tyler standard screens, has been applied to various groundwood pulps, and the coarseness modulus, together with other properties, has thus been correlated with strength and stiffness. These fractions show remarkable differences in physical properties, the coarsest fraction being very bulky and consisting of long, nearly perfect fibers, and the finest fraction being hard and hydrated, and consisting of short, badly ruptured particles.

A third important activity in the general field of evaluation studies has been the establishment of a tentative standard procedure for the evaluation of pulpwood. This has always been a difficult matter with which to deal, and although no claim to originality can be made, the methods available have been selected and organized so that a given lot of pulpwood can be judged commercially, physically, and chemically. Table III shows typical commercial and physical evaluation data, except for color, which appears as Table IV, and the chemical analysis is presented as Table V. The significance of most of these attributes is obvious.

Several important pieces of research in the Forest Products Laboratory are being directed toward a more precise understanding of the pulping reaction in general. Various species have been employed and delignification has been effected by means of a variety of reagents, such as caustic soda alone, caustic soda and sodium sulphide together, and a mixture of sodium bicarbonate and normal sodium sulphite. The nature of the reaction appears to be the same in all the cases thus far studied, and is capable of precise analysis.

Logarithmic relations between yield and duration of the reaction for four different temperatures are given in Fig. 2, while Fig. 3 presents the logarithmic relation be-

Table III—Physical Evaluation Data of Paper Birch, Eastern Hemlock, and White Spruce Pulpwood

Table 21—Physical Evolution Data of Paper Birch, Eastern Hemlock, and White Spruce											Calculated Weights of Peeled Wood	
Species of Wood	No. of Pieces in Cord	Weight of Cord Unbarked Pounds	Weight of Cord Barked Pounds	Solid Wood Content of Peeled Logs By Water Displacement Cu.Ft.	Loss in Weight of Bark (Peeled Logs) Per Cent	Loss in Volume of Bark (Disks) Per Cent	Moisture Content of Logs as Received (Disks)			O.D. Factor X Wet Weight of Peeled Logs Pounds	Volume of Peeled Logs X Weight per Cubic Foot Pounds	
							Unbarked (Green Basis) Per Cent	Barked (Green Basis) Per Cent	Bark (Green Basis) Per Cent			
Paper birch.....	68	5,680	5,119	88.1	11.0	8.9	44.1	45.0	34.8	2,820	2,837	
Eastern hemlock....	106	5,087	4,204	77.7	21.0	17.9	51.7	53.4	41.2	1,960	1,927	
White spruce.....	102	4,134	3,525	81.8	17.3	13.3	43.1	42.4	48.5	2,030	2,108	

Species of Wood	Average Specific Gravity	Average O.D. Weight Green Volume	Average Specific Gravity	Average O.D. Weight Green Volume	Average Weight per Cu.Ft. O.D. Weight Green Volume Pounds	Average Weight per Cu.Ft. O.D. Weight Green Volume Pounds	Diameter of Logs Peeled			Average Diameter (Disks) Inches	Average Age (Disks) Annual Rings	Growth Rate (Average Disks) Rings per Inch
							Maximum Inches	Minimum Inches	Average (Cord) Inches			
Paper birch.....	0.515	0.605	0.605	32.2	37.8	11.1	5.25	7.58	7.3	47.3	13.0	
Eastern hemlock....	0.398	0.430	0.430	24.6	26.9	8.3	4.00	5.76	5.8	94.0	32.1	
White spruce.....	0.413	0.478	0.478	25.8	29.9	9.6	3.70	6.00	6.35	78.0	24.7	

tween "apparent monomolecular velocity constants" and duration of the reaction for various temperatures. It is obvious that, when time of pulping is the only variable, only two experiments are required to predict the yield for any given time, and the prediction may be obtained either graphically or mathematically.

The weight of alkali consumed is a linear function of the weight of wood dissolved for any temperature of digestion within the range studied. This relationship can, of course, be expressed mathematically and the consumption of chemical can be calculated for any desired yield.

The velocity of the reaction is approximately doubled for an increase of 10 deg. C., or an equal yield of pulp having similar chemical properties with an equivalent consumption of chemical is obtained in one-half of the length of time. Such a comparison is given in Table VI, an arrangement of certain of the data.

The reaction, however, is not truly monomolecular. The velocity constants are calculated on the assumption of monomolecularity, decrease with time of pulping indicating a reaction of a higher order. Recently, it has been found that if the reciprocal of concentration of residual chemical, at any given period of digestion, is plotted against time of pulping, a series of straight lines is obtained, differing in slope as the temperature varies but passing through a common point. A similar set of straight lines is obtained when the reciprocal of lignin concentration is plotted against time of digestion. The reaction, therefore, appears to proceed as one of the second order.

Proceeding further along the general lines of increasing our knowledge of the effects of the process variables, a number of years' study of the sulphite process has culminated in a special course of instruction for mill men, which was recently given for the third and fourth times. Among the various activities that make up this course, a series of three sulphite digestions is made on a semi-commercial scale to demonstrate the effects of three radically different time-temperature schedules, temperature being without doubt the most important consideration in sulphite pulping. The results of these two series of three digestions each is presented as Table VII.

As the type of schedule is varied from convex through straight-line to concave, the following changes occur:

- The yield increases materially
- The unbleached color becomes somewhat lower
- The bleach requirement becomes higher
- The bleached color becomes somewhat lower
- The maximum developable bursting strength increases materially
- The maximum tearing strength decreases

The maximum developable folding strength increases materially.

Useful application of technical information, of course, is the ultimate aim of industrial research. Applied research holds the spotlight because it is the commodity that organized scientific endeavor produces for sale and that justifies, in the minds of most people, the continuance of such effort. The applied work at the Forest Products Laboratory is subdivided into three groups: Improved and increased utilization of (a) specific species, (b) pulpwood at the mill, and (c) waste. The amount of work done in each field is large but typical examples of each will serve to illustrate the trend of development.

An illustration of development under (a) is a recently devised method of producing a strong white pulp from the Southern yellow pines. This method includes modifications in both pulping and bleaching. The usual sulphate liquor is employed, but the ratio of chemical to wood is increased, while its concentration (dilution) is materially lessened compared to customary sulphate pulping practice. This procedure results in a good yield of comparatively strong and, at the same time, easy bleaching pulp. Bleaching can be accomplished with ordinary bleaching powder solution, applied preferably in two steps or stages, but since this results in some loss of pulp strength, a modified bleaching process has been developed wherein a first-stage treatment with chlorine water is followed by a thorough washing of the pulp and

Table IV—Color Analysis of Paper Birch, Eastern Hemlock and White Spruce Pulpwood as Shown by the Hess-Ives Tint Photometer

Species of Wood	Heartwood			Sapwood		
	Red	Green	Blue	Red	Green	Blue
Paper birch.....	59.5	42.5	31	74.0	60.0	48.5
Eastern hemlock....	59.5	41.5	33	59.5	41.5	33.0
White spruce.....	70.0	52.5	40	70.0	52.5	40.0

Table V—Chemical Analyses of Paper Birch, Eastern Hemlock, and White Spruce Pulpwood; All Values on Basis of Original Wood

Species of Wood	Cellulose Per Cent	Alpha Cellulose Per Cent	Lignin Per Cent	Alkali Soluble Per Cent	Hot Water Soluble Per Cent	Ether Soluble Per Cent	Alcohol Soluble Per Cent	Benzol Soluble Per Cent	Hydrolysis Number
Paper Birch....	61.4	41.6	23.8	19.3	2.8	0.9	3.2	25.3	
Eastern hemlock	53.0	37.8	34.5	14.0	3.9	0.5	4.1	18.5	
White spruce...	59.8	44.3	29.2	12.9	3.3	1.7	2.6	20.7	

Table VI—Effect of Increasing Digestion Temperature in Pulping to a Given Yield

Hours duration.....	Spruce and Caustic Soda			Black Gums and Sodium Bicarbonate and Sulphite		
	4	2	1	4	2	1
Temperature in deg. C.	160	170	180	150	160	170
Yield in per cent.....	66.85	65.58	64.80	77.36	75.69	75.28
Lignin in per cent.....	17.19	15.82	15.49	19.13	18.50	18.96
Cellulose in per cent....	49.8	49.6	48.4	51.30	51.10	49.80
Chemical consumed....	13.4	13.6	13.3	*2.75	*2.77	*2.72

*Expressed as grams. All other percentages are based on the oven-dry weight of wood used.

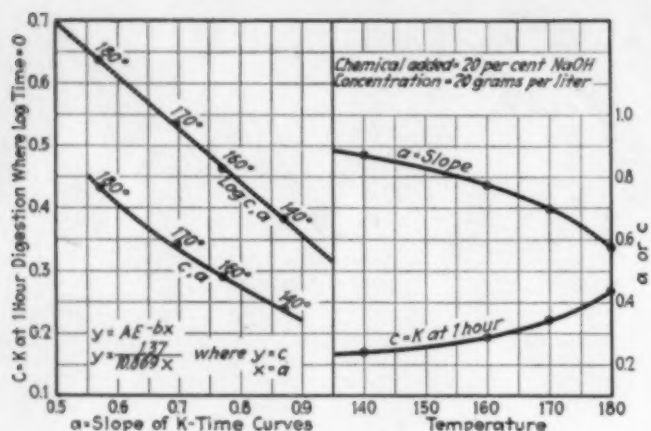


Fig. 4—Effect of Temperature on the Rate of Hydrolysis of Spruce With Sodium Hydroxide; Left, Relation Between Slope "a" and Constant "c"; Right, Relation Between Temperature and Values for "a" or "c."

its subsequent whitening with ordinary bleaching-powder solution. The chlorine treatment apparently brings about the formation of soluble, chlorinated derivatives of the dyestuffs in the pulp, which are removed in the washing, thereby rendering it more easily whitened and less affected in strength. As a matter of fact, sulphate pulps produced by the modified cooking method and bleached as described are frequently stronger than the unbleached pulp, presumably because of a slight hydration induced by the bleaching reaction.

The significance of this development deserves comment. The Southern yellow pine forests constitute one of our greatest forest assets. Moreover, the land reforests with great rapidity. Trees grow to pulpwood size in 20 years and to saw-timber proportions in 30 years, in many parts of the South. This assures a continued supply of pulpwood and a stability for the pulp mill that is to some degree lacking in other parts of the country. Up to the present time, however, technical difficulties have limited the pulping use of the Southern yellow pines to brown kraft wrapping papers and boards. While their consumption for this purpose is large and increasing rapidly, nevertheless the possibility of producing strong white papers and of competing on even terms with the more favored Northern pulpwoods is of tremendous industrial significance. The diversification of products thus encouraged cannot fail to improve the status of the entire Southern pulping industry, and is an excellent illustration of increased and improved utilization through application of research to a definite species.

In increasing or improving the use of pulpwood at the mill, two courses are open, both of which have been touched in the laboratory developments. The first method is to so improve and control standard pulping procedures that increased yield and improved quality result. This course is exemplified by the improved methods of sulphite cooking arrived at by fundamental studies and already described. Such a procedure maintains a definite standard of quality. The alternative is to increase yields by retaining more non-cellulosic materials in the pulp. This involves a change in certain qualities of pulp purity and physical strength. In the standard chemical pulping processes approximately half of the wood substance is

dissolved and a relatively pure cellulose results. In the mechanical or groundwood processes the reverse is true. The two products vary widely in quality. There is, however, a middle ground, where at some sacrifice in yield on the one hand, and of special quality on the other, a variety of useful pulps may be produced.

Recognition of this possibility has resulted in development, at the Forest Products Laboratory, of a series of "semi" processes, partly chemical and partly mechanical, whereby the yields of pulp from a given weight of wood substance are materially increased and qualities that improve the usefulness of the pulps over straight groundwood are retained, even though these processes are not adapted to all of the products in which standard chemical pulps are utilized. For instance, there is a semi-kraft process using ordinary sulphate liquor; a semi-chemical process employing a neutral solution of sodium sulphite and bicarbonate; and an acid process using standard sulphite liquor and termed the semi-sulphite process. All of these new methods are, in essence, quite similar. The chemical pulping or cooking is much less drastic than customary in the standard chemical pulping methods. The chips are merely softened and the fibers retain considerable quantities of lignin and other non-cellulosic wood components. The final step is a reduction of the softened chips to fibrous or pulp form through mechanical action. The processes, therefore, are partly chemical and partly mechanical.

One of the "semi" processes, the semi-chemical or neutral process, has come into rather wide commercial use in the past five years, having been found particularly suitable for the production of corrugated boards from extracted chestnut chips. These chips are a waste or by-product of the tanning extract industry, and this illustration is useful in bringing out both the utility of these semi-processes and the third phase of applied work, namely, improved and increased utilization of wastes.

In conclusion, the inter-relation of the various phases of work should be emphasized. The measure of developmental work is, in a large degree, its value when applied. On the other hand, the usefulness of such results, the rate at which they may be produced by a given technical organization, and the scope of the field they cover are in direct relation to the amount and the accuracy of the fundamental work on which they are based. The Forest Products Laboratory program is premised on the assumption that both fundamental and applied work, to be effective, must go forward simultaneously and with the proper emphasis on both phases. This brief outline is presented as evidence that this major premise is valid and is justified by concrete results.

Table VII—Effect of Variable Time-Temperature Schedules Upon Yield and Quality of Sulphite Pulp.

The conditions constant are: Wood, white spruce; maximum temperature, 148 deg. C.; acid, 5.5 per cent total, 1.2 per cent combined, 4.3 per cent free, 70 gal. per 100 lb. of oven-dry wood; penetration period, 1.5 hours; pulping period, 7 hours; and total time, 8.5 hours.

		Yield O.D. Pulp on O.D. Wood			Ives Color Un- bleached			Bleach Requirement 35 Per Cent Powder, Per Cent	Ives Color Bleached			Strength Develop- ment by Pebble Milling, Unbleached		
Digestion Type of No. Schedule	Total Per Cent	Screened Per Cent	Screenings Per Cent	Red	Green	Blue	Red		Green	Blue	Bursting Factor*	Tearing Factor*	Double Folds	
3347 Convex	45.2	43.3	1.9	76	67	62	14	88	90	84	0.83	2.06	200	
3357	45.9	43.8	2.1	71	60	55	14	89	89	85	0.87	2.35	200	
3350 } Straight	48.2	46.8	1.4	79	67	62	24	85	87	83	1.08	2.09	600	
3358 } line	50.1	48.1	2.0	71	61	54	26	90	87	83	1.17	2.17	900	
3351 Concave	52.0	49.5	2.5	74	60	54	30	91	83	75	1.17	1.73	750	
3359	52.3	49.4	2.9	69	58	52	30	..	..	..	1.21	1.76	800

*24x36—500 ream size.

Plant Management on Basis of COST CONTROL

By GEORGE A. PROCHAZKA, JR.

An engineer, not a professional cost accountant, presents these fundamentals of plant regulation and control. Born in New York in 1889, the author received his engineering degree at Columbia in 1913 and soon afterward joined the Central Dyestuffs & Chemical Company, Newark, N. J., where, as a chemical engineer, he was able to develop an unusual philosophy of cost control. This was crystallized for the first time in his book "Accounting and Cost Finding for the Chemical Industries," published in the Chemical Engineering Series in 1928. In the present article, viewing the subject from the eye of the plant manager, he speaks to the chemical engineer on the strictly mutual ground of interest in efficient plant operations.

IN THE DEVELOPMENT of a cost system we have two possibilities. We can create either a recording organization for calculating costs, or an analytical bureau for controlling costs. The continuous derivation of exact article costs is an expensive procedure which always arouses the suspicion that serious errors may be buried in the answer. Constantly to control costs so as to produce a desired result is practically a necessity. The very thought itself is an ideal of management, and the methods for doing this are relatively simple, accurate, and inexpensive. It would seem that cost control offers the most practical approach to our problem.

The effort to control bespeaks knowledge of the result we are trying to produce. Our mind, in the beginning, probably will not envisage this result as crystallized thought, but will hold it as a viscous magma which, under the stimulus of regulation takes the sharp form of true understanding. The effort to control refines crude thought. Thus there is a real advantage in solving the cost problem by the continuous use of control, as it is through the labor of holding performance to a prescribed course that we become conscious of what an organization really can accomplish.

Cost control starts with a theoretical analysis of what a manufacturing establishment should be able to do. The available facilities can perform a definite number of operations in a given time interval; a surplus capacity must exist for emergency use; and the sales organization can dispose of a given number of articles. From a study of these three factors, seasoned by experience, we can arrive at a feasible rate of production, from which we can more easily develop, through studies of subsequent operations, a correct rate for use in our cost calculations.

The detailed application of the principles of control necessitates the resolution of the manufacturers into such of their constituent parts as appear essential to the evolution of rational cost methods. Standards must be set for these elements. We start with what may be rather general approximations and use these values as yardsticks to measure performance continuously. By patiently studying all discrepancies we gradually learn the truth and obtain sound standards. Finally, we find out where to urge and where to check at the opportune time, and we become able to produce, under conditions with which we are familiar, the results we would like to have. The function of control is then in successful operation.

The great stumbling block to the detailed development of rational cost methods, and to their reduction to a common denominator for all business enterprises, has

been the failure to appreciate that the thing a factory has to sell is the proper performance of a process. To some people this thought will seem at variance with the facts. "We have goods to sell; we have byproducts to dispose of," they will say. That certainly is their immediate problem, for there does not seem to be any way of marketing process performance without using the finished article as a container, and the nature of the wrapper in no small way determines the profits to be derived from process performance. Manufacturing for a profit thus becomes a matter of effecting a working compromise between the somewhat divergent problems of selling and of producing goods. However, as soon as a factory has installed machinery, to get the greatest return from our investment we must sell to the best advantage the processes which the existing machinery will perform. This concept is one of the fundamentals of factory economics.

Suppose we examine this important thought from another angle. The normal business condition is one of free competition; but because it is burdensome men try to evade it by resorting to patents, to monopolies, and to other available methods for taking their affairs out of the ordinary. This makes many manufacturing enterprises anomalies, in that the true sources of profits are other than those found in the pure type, and consequently some people lose sight of the real situation. Under free competition we make money because we operate our machinery with greater skill than our fellows. This ordinary condition must be used as the basis for our cost methods because, in a scientific investigation, the abnormal must be referred to the normal. Regardless of the sources of our profits we must realize that the pure manufacturing problem in its essence deals with two elements, namely, the handling of materials and the performance of processes.

Now let us forget all about materials and concentrate on the fact that we want to regulate the cost of

processes. Process performance involves the expenditure for six elements, and the amount of each one that must be supplied depends on the nature of the industry in which we are working. A periodic tabulation of these components furnishes us with a basic control, because their total exhausts the possible expenditures. Each of these elements has distinctive characteristics. Depreciation bears no relation to the volume of process performance; it gives a fixed charge whose size is dictated by the policy of the operating company. Taxes also saddle us with a fixed cost. The third element, insurance, has the same features as the other two. Sundry expenses cannot be discussed in detail in this short article; some of its components will be fixed charges and some will vary with the volume of process performance. Supplies are bought approximately in direct ratio to production. Labor, used as a generic term to connote all payments for human services, brings both fixed and variable cost components. If these six process cost elements, fittingly subdivided to meet individual needs, are studied each month, we have taken the first step in cost control.

AN INVESTIGATION of the application of process cost elements leads us to a study of departmental organization. The departments of a manufacturing enterprise may be exhaustively divided into three groups: commercial, production, and service. The first acts to keep the business as a whole running. The second turns out goods. The third assists the other two in their work by supplying such services as transportation, maintenance, power, and so on. Although the guiding principle of departmental organization is functional activity, the actual cleavage lines are determined by the volumes in which these things exist. When a function is not present in a sufficiently large amount it must be merged with some other activity to which it is closely related. Such combinations may not give a satisfactory cost picture. Organizing departments so as to meet the dictates of management and cost control is one of the fundamental steps in the development of an adequate system.

The second and possibly the most important phase of cost control is to get a vivid picture of the cost of running each department. Much of our success or failure hinges on this point. If we are to develop a good technique, these figures must come to us in terms of the six elements of process costs plus the value of the functional activities which each department has received from the various members of the service group. We can then give all department heads costs which can be reconciled with the general books of account and we are able to present them in a simple way. After this it becomes their duty not only to do good work but also to do work at a satisfactory price. Thus we follow a sound principle of management and put a burden on the shoulders which should bear it. A knowledge of departmental costs is one of the fundamentals of cost control.

The three groups of departments produce four results: (1) We obtain a general overhead or burden of expense which represents the cost of operating the commercial departments. (2) We will have some new facilities in the form of construction work, manufactured supplies, new inventions, and so on. (3) Part of the fundamental cost elements which we have brought together will be dissipated as wasted effort or will yield an extra profit because things have worked out better than we thought they would. (4) Salable process performance will be on hand in the form of partially or completely manufactured goods.

As COST ACCOUNTING is one of management's most useful tools, every executive should know, in a general way, just what he can do with it and what he cannot do with it. Like all other things, this tool has its limitations, which we must not overstep if we want to use it effectively. Though the advocates of cost work have fortified their arguments by pointing out the many benefits to be derived from the

In a broad sense every department of a manufacturing establishment performs a process of some kind. Some of them, it is true, are not easily standardized, measured, and reduced to a unit basis. With the output of the commercial departments, such as administrative, sales, office, and so on, we are not particularly concerned in this discussion. Their activities are conducted for the welfare of the business as a whole and have no bearing on the cost of performing individual productive process. This group creates a burden of expense which must be treated as an offset to the gross profit obtained through the sale of goods. Such a general overhead can be regulated if there is a desire to do so.

Differences between the service and the production department lie in the use to which their processes are put. The same identical shop operation may be a service in one factory and a productive process in another plant. From a controlling point of view there is no difference between an operation performed on the lathe of a machine shop or in the vat of a chemical factory. When processing equipment is applied exclusively to the manufacture of one article, less detail must be carried on the books of record than when many different articles pass through one machine for a productive operation. The selection of proper units for measuring the processes of the production and the service departments cannot be taken up here, as that would get us into details which are peculiar to a particular industry. The admonition to use great care in choosing logical units is in order.

DEVISING a proper technique for control of process costs is important. Performance standards must be worked out in terms of the elements which have been used to calculate departmental costs. This enables us to contrast the salable value of our output with the actual cost of running the productive departments. A comparison of this kind makes it possible for us to unearth the underlying causes of a negative or positive departure from our goal position. When there is a deficit we have wasted part of our process performance and when there is a surplus we have added to our profits. Over a substantial period of time we must strike a zero profit-and-loss point or change our standards of performance. As the components that have contributed discrepancies are plainly visible on the books, it is not necessary to become perturbed on account of the innumerable cost fluctuations which are a common occurrence in every factory. An examination of the facts will tell us just what adjustments must be made in the conduct of our enterprise. An executive who analyzes his costs in this way will soon be the master of them.

use of a system, it is sufficient to know that it gives a convenient method for measuring factory performance, to the end that we may get the greatest return from the use of the facilities at our disposal. Our problem, therefore, is to find out the most practical way of making a cost survey and to understand the salient features in this task of evaluating the production and output of our commodities.

Goods are sold on the basis of predetermined costs and it is a factory's function to get them out at this price or better; it should not be overlooked that sales scheduling and production planning are essential ingredients of this accomplishment. It is in a searching analysis of wasted effort—i.e., the discrepancies between actual performance and our standards—that the greatest opportunity for controlling costs resides. Such differences may be either a profit or a loss inasmuch as we can exceed or fall behind the standard of accomplishment we have set for ourselves. On analysis wasted effort may turn out to be nothing more than a temporary change in the price level of the cost elements. Combinations of the price and the performance factors will hide a serious internal situation if these components should neutralize each other. Cost methods, properly devised, will always bring to the attention of a managing executive the exact reasons for all departures from correct practice and will not let any significant events go by unnoticed merely because they have not visibly affected the final results. To get goods out at a price we must know underlying causes.

LET US SUMMARIZE the major steps in the control of process costs. First, we must establish the six elements of process costs and so arrange and subdivide them as to give us, each month, the most effective and vivid picture of the total expenditure for operating our enterprise. Second, we must calculate the actual cost of running each department, and this must be done in terms of service charges and process cost elements. Third, we must evaluate our process performance at standard cost so that we can contrast these values with our total expenditure and find out the reason for all departures from anticipated performance.

A controlling technique for materials has two separate phases. To try to unify the price and the quantitative check on goods into one system is an unsound departure from the fundamental concept that each of these duties belongs to a separate group of workers. This results in neither end being properly prosecuted. A purchasing department is primarily concerned with buying goods cheaply and should know its consumption; but the routine factory details are of no value to it whatever. A production department may find the immediate purchasing problems entertaining gossip; but this does not help them in quantitatively accounting for the goods they have received and in showing that they have used them to the best advantage.

It is difficult to consider anyone's material-pricing tactics sound unless he has recognized the fact that goods are invariably sold against a preconceived notion on their

probable cost of production. We think we can go out and buy materials low enough to show us a profit. Sometimes we are able to do better than we thought and again we are faced with severe encroachments on our profits. What we really want to know is not how much our costs go up and down with the swings of the market but how much leeway we need in the buying of a particular raw material.

From these considerations it would seem logical to assume that into the vast array of calculations which are a part of a cost system we should inject our materials at those prices which experience has shown to be reasonably safe figures. Some accountants may object to this and say that we are violating one of the fundamentals of their profession in that we are anticipating profits. The approximations of cost work lead to many other unconscious violations; but this one serves a useful purpose in that it greatly amplifies the cost method. Further, surpluses created in this way need not be considered as an increment of income; but can be used in proper amounts as an offset or reserve against inventories. A variation of this thought is followed by Anaconda, International Harvester and other large corporations. To sum up the thought in a homely way: put a price on your materials and stick to it in your cost calculations until experience tells you it is time to change.

As the buying and selling activities of a company determine its profits the cost story cannot be considered authentic until it has been tied in with the general books of account. This is a simple matter if, as has been pointed out earlier in this discussion, the cost calculations have been so devised that they match up with the general ledger accounts. Then the costs, taken from the focal points of the system, can be entered in a divided column journal and in a simplified manner can be posted to the regular books.

THERE are seven pivotal cost records and six of these will be found in every business. The first brings together the six fundamental process cost elements. The second considers departmental costs. The third shows the result of operating the departments and concludes the process phase of the calculations. The fourth record handles the raw material figures. The fifth controls work in process; it is at this point that the process and the material charges are united to get article costs. The sixth record is found only in those enterprises where the finished product is assembled from previously manufactured items which for convenience are controlled by an account such as "Component Parts" or "Component Materials." The seventh record gives the well-known finished stock account. To provide channels for the cost data to flow into these central records is a fundamental concept.

A discussion of cost control is not complete until something has been said about the importance of order in the factory. Pick out a disorderly plant and you will find the cost reports are not worth the paper on which they are written. Work must be done in ways that make an accounting possible. An unfortunate routing of materials due to misplaced machinery, or an excessive number of small volume units, or other maladies, may make the installation of a system difficult. When rational methods are not effective the fault will be found in the operations and not in the system. Sound manufacturing practice and skillful cost accounting tactics have no difficulty in working together to the common end, maximum profits.

Chemical Warfare Service

SAVES MILLIONS

For INDUSTRY

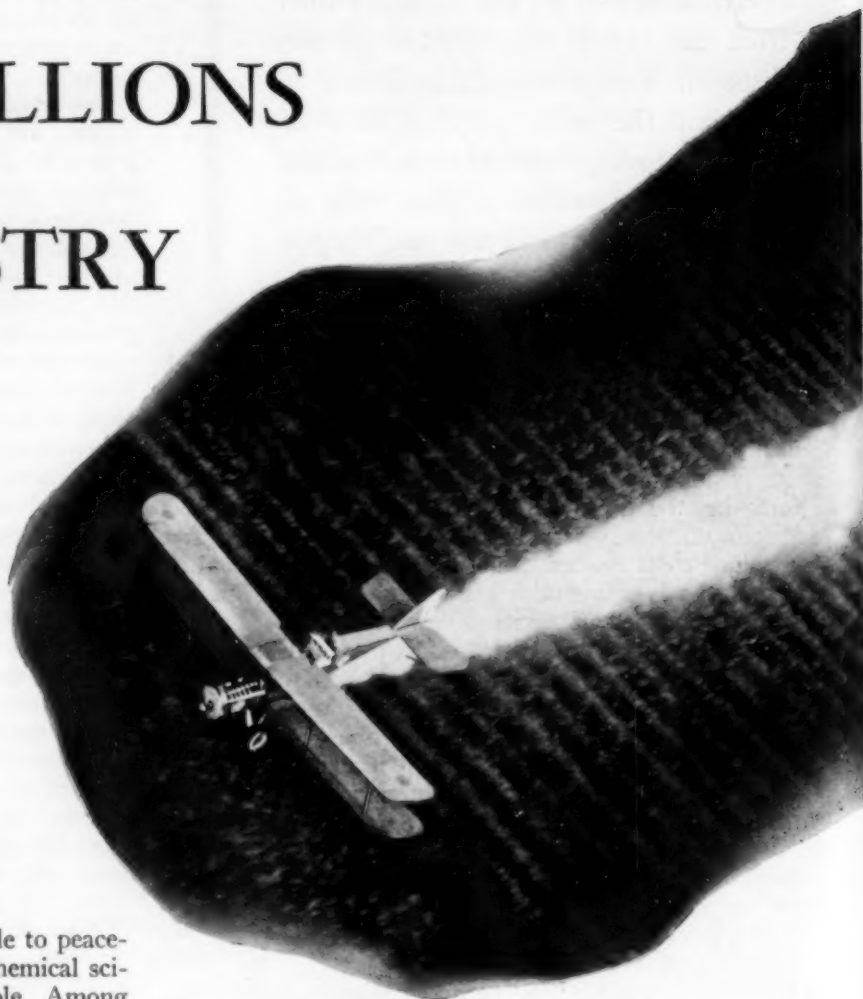
By ROBERT E. SADTLER

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Formerly of Chemical Warfare Service
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CHIEF DUTY of the U. S. Chemical Warfare Service, of course, is purely military; first the development of such smoke apparatus, projectiles, and toxic materials as are required by the other services; and second, the organization, equipment, and training of chemical troops. In addition to these two missions, however, this service has proved itself valuable to peacetime America by important contributions to chemical science and to the industry of the nation as a whole. Among the more important of these is the development of compounds that will destroy the boll weevil more effectively than the calcium arsenate generally used; it has demonstrated the use of tear gas in controlling mobs; it has developed gas masks for protection against industrial poisoning and ammonia fumes, and for the use of the public health service in its work of fumigating buildings. It has assisted the shipping industry by three commercially valuable developments: toxic ship-bottom paints, protection of marine piling, and a safer and more effective method of ship fumigation.

Anti-fouling paint, according to the estimate of competent authorities, will save the shipping industry from \$125,000,000 to \$150,000,000 annually in reduced fuel and maintenance costs. The annual appropriation for this branch of the army, it should be remembered, is an infinitesimal fraction of this amount; and this contribution to industry is only one of many made by the diligent and efficient research organization of the Chemical Warfare Service.

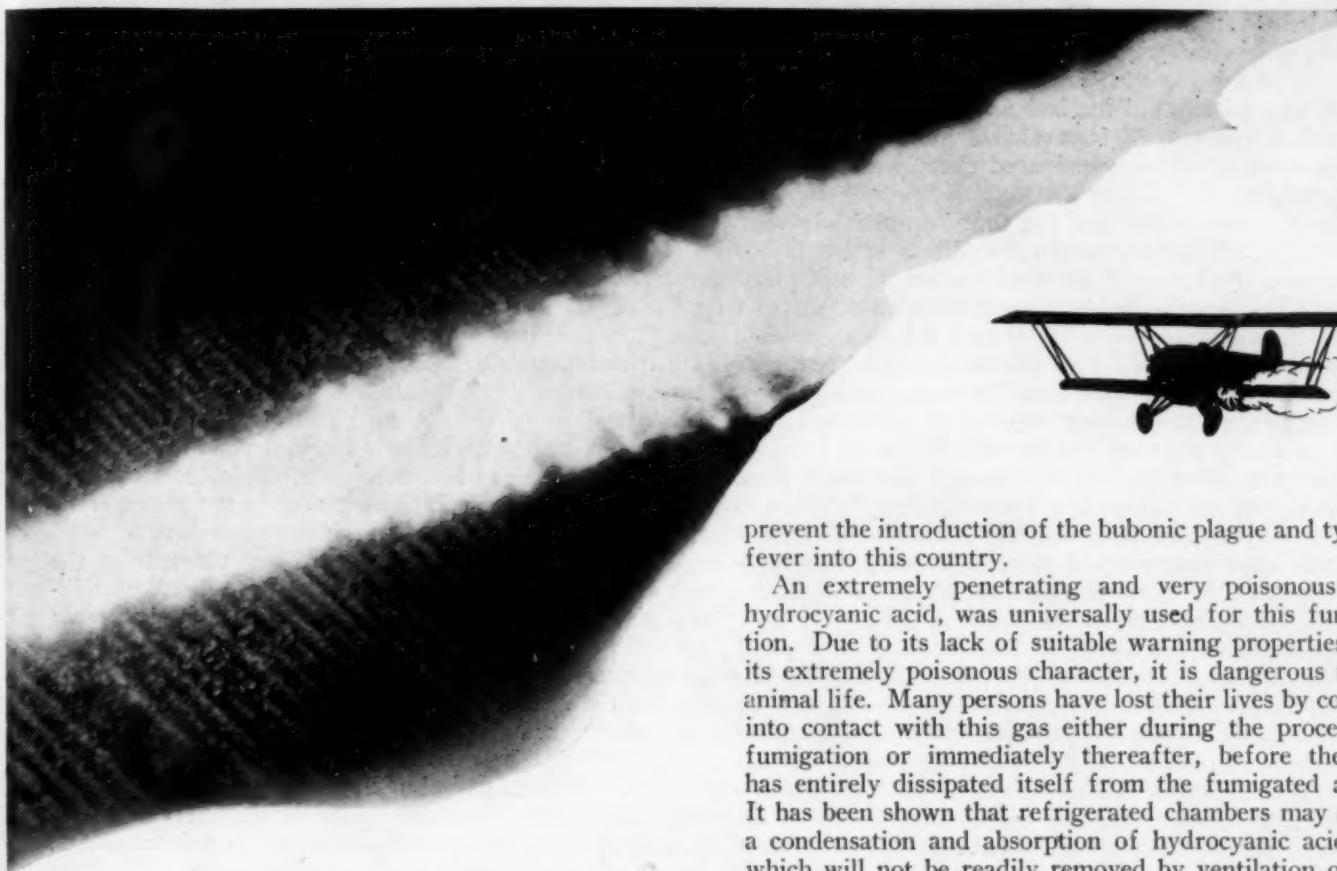
The need of a poisonous paint for the exterior of hulls of ocean-going vessels is due to the accumulation of marine organisms, which increases fuel consumption and reduces the ship's working time by the amount spent in dry dock



Dusting Boll Weevil Toxic Preparations on Cotton Fields

to clean the bottom. Barnacles are the principal marine organism attaching themselves to the ship's bottom. Not only commercial but naval vessels are affected by this growth. To naval vessels, speed is of the utmost importance during all actual engagements—the difference between defeat and victory perhaps depending upon the attainable speed.

As a solution of this problem, two different types of toxic paints were developed: the varnish type, which is applied cold and dries by evaporation, and the hot plastic paint, which is applied in a melted condition and solidifies on cooling. Hot plastic paints are more expensive to apply, as they form a much heavier coat than the varnish type. They are much more durable, however, and are advised for use on long cruises, when the ship needs protection for a considerable period. This type of paint was tested on the bottoms of several destroyers and gave excellent protection on exposure to marine growths. The varnish type consists of a vehicle, such as gum or resin, a pigment giving body and color to the paint, a volatile solvent which acts as a thinner, and the poison. Many materials were tested experimentally in the effort to find the proper relation between the poison and the vehicle. The most effective poisons are the oxides of copper and mercury, and the most



promising vehicle, resin, modified by coal tar or other plasticizers.

In 1923, at the request of the National Research Council, the Chemical Warfare Service undertook to find a poison which would offer effective protection against marine borers, that destroy docks and other waterfront structures. The annual loss due to these borers is estimated at over one million dollars.

Investigations were made at Beaufort, N. C., where in the waters there could be found the principal types of marine borers. The Service was greatly aided in the investigation by the Quartermaster Corps, U. S. Army; the Navy Department, and the Department of Commerce, which supplied funds and laboratory facilities.

Straight creosote, usually used on waterfront structures, will not stop the borers. About 15 chemical compounds are known at present which furnish from 25 to 50 times greater protection against marine borers than creosote. The protection offered by creosote alone may be increased very materially, at slight cost, by the addition of some one of the poisonous compounds mentioned above. Fuel oil plus a specific poison will give better protection than is afforded by creosote at a lower initial cost.

The use of these poisons will not involve any change in the present commercial methods of treating piling and there is little or no increased hazard in the installation of this piling.

Every ship entering a harbor from a foreign port must be fumigated—if not by its own officers, then by the officials of the U. S. Public Health Service. The purpose of this fumigation is chiefly to

prevent the introduction of the bubonic plague and typhus fever into this country.

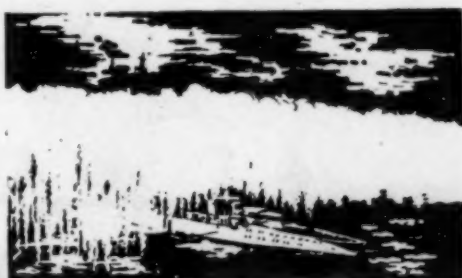
An extremely penetrating and very poisonous gas, hydrocyanic acid, was universally used for this fumigation. Due to its lack of suitable warning properties and its extremely poisonous character, it is dangerous to all animal life. Many persons have lost their lives by coming into contact with this gas either during the process of fumigation or immediately thereafter, before the gas has entirely dissipated itself from the fumigated areas. It has been shown that refrigerated chambers may cause a condensation and absorption of hydrocyanic acid gas which will not be readily removed by ventilation of the chambers. When the temperature rises in these chambers, sufficient hydrocyanic acid will be volatilized to prove fatal. Deaths have occurred by leakage of the gas through cracks into adjoining rooms. Due to the weak odor of the hydrocyanic acid gas, the average person is not warned before he is overcome.

The Chemical Warfare Service together with the Public Health Service has developed a scientific method of fumigation whereby adequate warning of the presence of hydrocyanic acid is given before it has reached a dangerous concentration. A potent tear gas, cyanogen chloride, is generated along with the hydrocyanic acid gas at the time of fumigation. This tear gas causes irritation and stimulates the tear gland of the eye, thus giving evidence of its presence and also warning of the presence of the deadlier but more insidious gas. This fumigating mixture is generated by adding a mixture of sodium cyanide and sodium chlorate to hydrochloric acid. This new and safer method has been adopted by the Public Health Service and is now in use.

Contributions to the shipping industry have been noted above, but that is not the only field to which the service has directed its peace-time activity. Agriculture also has profited by its research. Ravages of the boll weevil is one of the serious economic problems of the cotton growers of the Southern states. Millions of dol-

lars worth of growing cotton has been destroyed by this insect, and many millions of dollars have been spent by the federal government and the states affected in the effort to control it.

The Chemical Warfare Service was authorized by Congress, in



1924, to investigate methods for the control of the boll weevil. Numerous requirements had to be met in the selection of a poison. It must (a) adhere to the cotton plant; (b) quickly kill the boll weevil; (c) not damage the cotton plant; (d) be available in large quantities and be capable of being prepared cheaply and must be easily applied.

Three poisons which met the four requirements were found: (1) A special sodium fluosilicate which is obtained as a byproduct in the manufacture of acid phosphate; (2) a special barium fluosilicate, and (3) a special calcium arsenate with 20 per cent arsenic as arsenic pentoxide, as compared with the 40 per cent arsenic of the commercial calcium arsenate. Of these three poisons, the two selected as the most effective are the special calcium arsenate and the sodium fluosilicate.

Neither of these poisons will damage the cotton plant and both possess a high boll weevil toxicity. The raw materials needed in the manufacture of these poisons are sufficiently common and plentiful to supply any possible demand. Both are comparable in cost with calcium arsenate on a pound-per-pound basis.

Sodium fluosilicate does not stick to the cotton plant as well as calcium arsenate, but it is a quicker weevil-killing agent. Moreover, by a special process, it may be made equal to the calcium arsenate in adhering qualities without thereby impairing its effectiveness as an insecticide. The Chemical Warfare Service also has demonstrated that calcium arsenate can contain as low as 20 per cent arsenic and still be as effective as the present product containing 40 per cent arsenic. An effective new method for the manufacture of this special calcium arsenate has been developed and it can be utilized commercially.

Another interesting discovery made by the Chemical Warfare Service is that of the use of tear gas in controlling crowds and individuals. The effectiveness of this method in comparison with the old one of subduing the mob by the free use of bullets has been demonstrated frequently. A simple tear gas, chloracetophenone, in harmless, non-explosive tear-gas grenades, may be used as effectually without permanently injuring anyone who may encounter it. This tear gas is a non-poison in the concentrations obtainable in the open air, and yet is effective even with one part of tear gas to three million parts of air. Its only reaction is to cause smarting of the eyes and the stimulation of the lachrymal gland, causing a copious flow of tears.

Still another service which the Chemical Warfare Service has rendered to peace-time America is the development of various kinds of gas masks as protection against the deadly gases employed in many industries, and the

detailed study of methods to prevent the fatalities resulting from other forms of poison. Since all of these poisons have at one time or another been brought to the attention of the Service as possible chemical warfare agents, the Service has necessarily made a close study of them and of methods of protection against them, and has been able to offer freely the knowledge thus gained to industry.

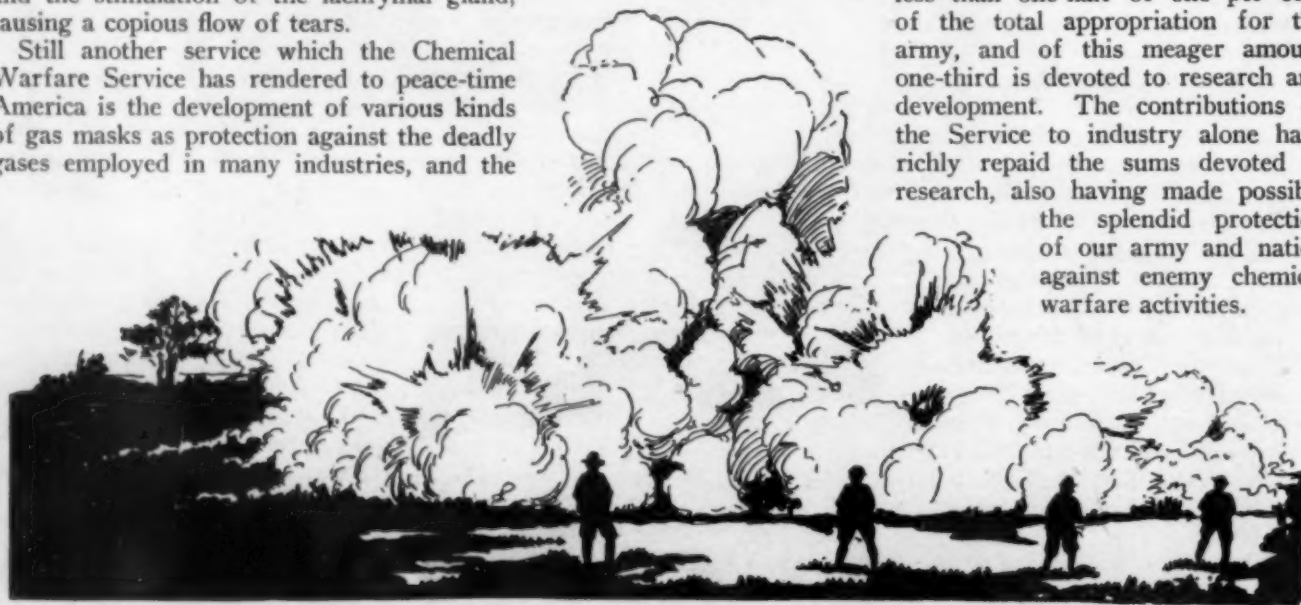
The Chemical Warfare Service not only devised a mask which offers complete protection against carbon monoxide but brought forth two valuable byproducts in the process: First, a better and cheaper method of making iodine pentoxide; and second, a simple detector of carbon monoxide which causes a color change from the original white of the detecting material to bluish-green, then violet-brown, and finally black, depending upon the concentration of carbon monoxide. This indicator will show quickly and accurately whether or not a dangerous concentration of carbon monoxide is present.

Results of this research have been adopted by the navy for submarine crews and by a large number of industrial firms. The carbon monoxide detector has proved its value in mine rescue work and recovery operations after fires and explosions. It may also be used for testing the air around gas producers and blast furnaces and wherever carbon monoxide is a hazard.

A third type of gas mask developed by the Chemical Warfare Service has been of use to still another field of peacetime activity: the Public Health Service. It is employed in the work of fumigation. A poisonous gas, hydrocyanic acid, and a tear gas, cyanogen chloride, were the two gases in which the mask was to be used and it must therefore have a high capacity for absorbing them. As a result of thorough study of absorbents for these two gases, two chemical compounds were found which were particularly effective in absorbing them.

The Chemical Warfare Service has special talent and equipment for investigations in the field of poisonous materials and protection therefrom. As soon as a problem is solved and a new device is produced, it does not attempt quantity production or to supply commercial needs. It manufactures the quantity immediately needed by the government, and publishes an account of its findings, so that commercial firms may engage in the manufacture if they desire.

Appropriation for the support of the Service averages less than one-half of one per cent of the total appropriation for the army, and of this meager amount one-third is devoted to research and development. The contributions of the Service to industry alone have richly repaid the sums devoted to research, also having made possible the splendid protection of our army and nation against enemy chemical warfare activities.



What Price Chemical Engineering?

By JAMES H. COLLINS

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A CHEMICAL ENGINEER worked out a process in which the dry climate of the Southwest favorably affected the product.

"What are the night humidities of Los Angeles?" he asked a consulting meteorologist.

"What part of Los Angeles?" countered the latter.

"I mean, what are the official figures?"

"There are no official figures," said "Old Probabilities." "This town has an area of nearly 450 square miles. If you made that chemical downtown, in the office building where the Weather Bureau is located, there would be the only official figures available. To get what you ask for, I must set up instruments at your factory, and take the local measurements for at least a year. Weather is just as local as that."

"How much will it cost?" asked the engineer, and this is the point of my story. Such weather observations are rather costly. A year's observation for the location of an airport, with interpretation of the data—the big thing—costs several thousand dollars. The man of the slide rule understood the man of hygrometers and anemometers, because he had cost difficulties of his own.

The cost problem of the technical man in all fields is twofold: First, to do a good job, the layman must often pay more than he expects to pay, and gets a shock when the cost is given. Second, the cost may be less than he thinks, and his fear of expense keeps him away from the technician, and the expert assistance that would enable him to do a good job. The chemical engineer, and technician generally, has a price problem exactly like that of the salesman who is selling something that sounds expensive but is really cheap when the customer understands what he is going to get for his money.

The Chamber of Commerce committee charged with the selection of an airport site experiences a chill when the consulting meteorologist tells them that he belongs in their picture, and that his fee will be seven thousand dollars for a year's work. But as an airport site easily runs into a million dollars for land alone—a thousand acres at a thousand dollars per acre—this fee is insurance at a cheap rate. The meteorologist insures that aircraft will find the field favorable for landing, and so patronize it.

YOU have yourself been a prospective customer in the hands of a skillful salesman working to sell you something of price, and probably have been impressed with his maneuvering to avoid discussion of price. If you haven't, I advise you to call in a life insurance salesman, and explain to him that you want a certain amount of protection, and to deliberately insist upon ascertaining the cost first of all. Try to get it! He will soothe you, and compliment you, and evade you, and tell you that he is coming to that in a minute, and when he finally does tell you the cost, it will appear a mere detail compared with what you are to get.

The salesman works to build up in your mind a clear picture of what life insurance will do for you. He understands your reactions as you are pulled on one side by desire, and on the other by money, and adds his effort to

the desire pull so that the thought of the money you are to part with will not be as strong as desire when he produces the application blank.

Now chemical engineers understand that something of this sort is needed in their own work. Some chemical engineers become quite adept in control of these human reactions, and thus develop into executives running important enterprises, generally admired by their fellow technicians. Can all technicians acquire this "sales sense?" Yes! And have considerable fun doing it.

The technical man starts with a handicap, compared with the fellow who becomes a salesman. So, the first step, for him, is overcoming that handicap. The salesman is almost always social, likes people, loves to watch their actions, and study the operations of their minds. The technician generally is not social. Far from being interested in people, he dreads the intrusion of their personalities in his study of scientific phenomena which are often quite complicated enough, without a client asking how much it is going to cost, or a board of directors demanding "What is it good for?"

SALESMANSHIP is mainly explanation. The technician has not sold chiefly because he has not explained. A salesman is constantly thinking up ways to present his project clearly, and from the viewpoint of the customer. The technician can do this. He can adopt two or three basic mechanisms of the salesman, in dealing with the prospective client, and get as good results as the book agent.

The book agent says, "You will enjoy these books." The prospect objects, "I never read books." Your children will like them." "I have no children—only a cat." "You will find them handy to throw at the cat."

That is the first mechanism—always explain from the customer's viewpoint. The word *you* gets pretty bald and obvious to some of us, in advertising and selling. But that is because we don't want the article exploited. Psychologically, *you* is always right.

To illustrate in a technical situation: A manufacturer brought a problem to a chemical engineer, a defect in product that looked like simple trouble, to be cured with a little chemical magic. The engineer found that this manufacturer needed a controlled process. His process had grown like Topsy. The engineer thought of the technical work needed to systematize that process, the elements of uncertainty in some parts, and so on. He thought of his side, in a word, instead of the prospective client's. The client grew apprehensive, and wanted to know how much all that work would cost. When the engineer guardedly named a minimum figure, the client visibly shrunk. To reassure him a little, the engineer explained the technical complications involved. The manufacturer shrunk still more.

A book agent, of course, would have used the mechanism of *you*. Yes, the problem was complicated, but the manufacturer would have a product free from trouble. Yes, it would cost some money—but how little when distributed over five years' output!

Another mechanism of selling is equivalent to putting on the suit of clothes and inviting the customer to admire himself in the triple mirror. I know an automobile salesman who sold quite a few seat covers by showing his customers samples of the cloth. When he got larger samples and laid them on the seat, he sold more. When he got actual covers and buttoned them on the seat, his sales doubled.

The technician must be certain of his ability to give

the client something tangible, or it isn't a job. It is not blatant to emphasize such results. "With a controlled process," a book agent would point out the customer, "you will have more time for golf!"

Still another bit of selling psychology applicable to the technical man's sale is the avoidance of all reference to uncertainty. People do not like to think of failure.

Some years ago, a mining accountant hit upon a good idea: the development of a promising group of claims by the sale of ten-dollar shares, one to each purchaser, on the principle that nobody risked much, while the rewards would be great if a mine was made. Being a technical man, the honest accountant reminded prospective shareholders that the claims might prove worthless. He lost many a sale, because people do not like to think of losing even ten dollars.

Well, the mine turned out big—a ten-dollar share in it is today worth about four thousand dollars! The accountant has since financed other projects on this plan. But after his first experience, he allied himself with a salesman, who without glossing over the risk, says to prospective purchasers, "If you win, you will win big!"

Now, the other day I heard a sales manager cleverly demonstrate that principle to a chemical engineer. The salesman was asking the technical man about the possibilities for improving a process by chemical control. The

engineer with professional caution, would not promise results.

"We may carry the investigation through to the end," he said, "and find that such-and-such a result cannot be secured."

"Why, that in itself will be a result!" exclaimed the salesman. "That will be worth money to our company. Because, if we can't do it, we will waste no more time trying—and we will know our competitors can't do it."

The four classic steps are: (1) Attracting attention. (2) Arousing interest. (3) Securing conviction. (4) Getting the order. As the technician's prospective customers usually come to him, he has little difficulty with the first two steps of his sale. Attention can be attracted, and interest aroused, by general "propaganda" for technical ability, along lines which were dealt with in previous articles (*Chem. & Met.*, August and October, 1929).

And the technician has an advantage over the salesman in securing conviction. For people, coming to him as a scientific man, rely upon his scientific impartiality. They understand that the salesman exists to sell them something, and will make partial statements. So the technician has a better audience. If he clearly explains results that are possible, the sale may make itself, because people generally find a way to pay for what they are convinced is desirable and what they value.



Recovering Lead in Rubber Factory

By F. L. HAUSHALTER

Development Engineer
B. F. Goodrich Company

WHEN WE SAY that lead melts at 621 deg. F. and has a tensile strength of 1,900 lb. per square inch, we have in mind pure lead that has not been remelted many times in crucibles that are not always clean. This metal, too, as ordinarily used in pipes and conduits has been drawn; stresses have been set up in the lead by this process, and their magnitude depends upon several factors, such as temperature of extrusion, extent of oxidation, rate of cooling, and impurities accumulated in the remelting.

Where lead is melted and extruded onto wire and hose the tensile strength of such lead, when removed from the wire or hose, has increased to about 2,400 lb. per square inch. The percentage elongation, however, has decreased from about 50 to about 25. Industries where lead is used again and again by remelting, as in the rubber industry, where hose is vulcanized in a lead casing, the casing removed after vulcanization of the hose, and remelted, the problem of controlling the physical properties of the lead becomes a serious one.

After pure lead has been extruded onto the hose and the tensile strength, thereby, stepped up to about 2,400 lb. per square inch, the tensile strength then falls appreciably below the original value of 1,900 lb. per square inch as soon as the vulcanization process begins, the temperature of vulcanization being 280 deg. F. When samples of the lead, as stripped from the hose after vulcanization, were tested for tensile strength at various temperatures, the curve approximated a straight line. A stress-strain curve on the lead at a temperature

of 280 deg. F. indicates that at a tensile stress of about 600 lb. per square inch the lead begins to yield, for the curve departs from the original slope.

The curve for dross lead, or removed scum, shows a straight line almost to the breaking point, which occurs at less than 700 lb. per square inch. The curve for refined dross—lead from which the scum has been removed by the ordinary process of ladling—shows good characteristics up to 900 lb. per square inch, and then fails at little more than 1,000 lb. per square inch. Pure lead, from the pig, follows the straight line up to about 700 lb. per square inch, then gradually departs from it, as one would expect. Samples removed from lead-covered hose before and after vulcanization indicated that the stresses have been somewhat relieved by the heat treatment, for the curve drops below that for pure pig lead, although the ultimate tensile strength is greater than that of the pure pig lead.

The following table indicates that the tensile values are practically the same:

	Tensile Strength-Lb. per Sq. In. at	
	80 Deg. F.	280 Deg. F.
Pure lead, pig	1,880	1,239
Lead tube, before cure	1,930	1,345
Lead tube, after cure	2,390	1,385
Refined dross, ready for production	1,810	1,118
Dross	400	650

By setting up a daily control test on the tensile strength of the lead, a safe working stress of 600 lb. per square inch in the lead can be assumed. By using an internal pressure of 125 lb. per square inch on the hose and an external pressure of 35 lb. per square inch in the heater, the effective maximum pressure the lead must counteract is 65 lb. per square inch. Using the formula: $PD = 2tf$ where: P = effective pressure, pound per square inch; D = inside diameter of lead tubing; t = wall thickness, inches; f = 600 lb. per square inch working stress; a table of wall thicknesses for various hose diameters may be tabulated.

A STUDY OF THE Thermal Aspect of Liquid Phase Sulphuric Acid Production

By PERCY PARRISH

Chemical Engineer, London, England

NO ESSENTIALLY scientific contribution appears to have been published on the subject of the thermal aspect of chamber sulphuric acid manufacture, nor indeed has any really serious attempt been made to establish a basis by which the various types of sulphuric acid reaction chambers can be appraised as regards ultimate efficiency. The importance of this subject, however, has been urged repeatedly by the writer.

Several chemical engineers have asserted that it is possible to have too much cooling, while others hold the opinion that effective working of a chamber plant (whether rectangular or vertical, as in the case of towers) requires a hot core and a cold surface. These matters, on the other hand, do not appear to have been examined in detail, or elucidated in any way. It should be possible to advance the subject a stage further.

In the February, 1929, issue of *Chem. & Met.* an article by the writer included a view of a Gaillard-Parrish sulphuric acid plant at Voves, France. This plant has been operating satisfactorily on the liquid phase system for more than three years, and has established the fact that it is possible to operate at 3 to 3.5 cu.ft. of chamber space per pound of sulphur per 24 hr., with something like the same facility that ordinary chambers are worked at, say, 15 cu.ft. of chamber space. The system is no longer experimental and has

definitely been shown to be entirely practical in nature. The results for the month of March, 1929, typical of normal operation at the Voves factory, were as follows:

Acid made..... 1,245 tons, 53 deg. Bé.
Pyrites burnt.... 673 tons = 19,801.6 lb. sulphur per day.
Sulphur content of pyrites..... 47.5 per cent
Quality..... Aljustrel and Tharsis.
Pyrites in cinders... 2.53 per cent sulphur.
Nitrate of soda consumption ... 14 lb. NaNO_3 per ton of 53 deg. Bé. acid made; or 2.93 per cent nitrate of soda on the sulphur equivalent of the acid made.

The arrangement of plant is shown in the accompanying drawing and is largely self-explanatory. It will be seen that it consists of four 5-ton mechanical pyrites burners, an electrostatic dust chamber, potting oven, one Glover tower, three tower chambers and two Gay Lussac towers. The writer has made a study of the heat distribution in the plant, which is discussed in the following pages.

Table I—Data on Gaillard-Parrish Liquid Phase Chamber Plant at Voves, France

Plant dimensions		Quantity and Strength of Circulating Acid		
Glover tower.....	4 m. diam. x 12 m.	Quantity Fed Per Hour	Strength Fed, Per Cent H_2SO_4	Strength Leaving, Per Cent H_2SO_4
No. 1 chamber.....	7 m. diam. x 18 m.			
No. 2 chamber.....	7 m. diam. x 18 m.			
No. 3 chamber.....	7 m. diam. x 18 m.			
Sulphur Burned				
20 tons pyrites (48 per cent sulphur) per day.				
Efficiency of combustion, 96 per cent. Equals 860 lb. sulphur per hour producing burner gas of 7 per cent SO_2 content by volume.				
Distribution by Acid Production				
Glover tower.....	25 per cent			
No. 1 chamber.....	38 per cent			
No. 2 chamber.....	25 per cent			
No. 3 chamber.....	12 per cent			
Temperature of Gases in Plant (deg. C.)				
	Entering	Leaving		
Glover tower.....	400	100		
No. 1 chamber.....	100	52		
No. 2 chamber.....	52	32		
No. 3 chamber.....	32	20		
Temperature of Acid in Plant (deg. C.)		Entering	Leaving	
Glover tower.....		20	125	
Chamber acid.....		20	...	
Nitrous vitriol.....		35	...	
No. 1 chamber.....		16	58	
No. 2 chamber.....		16	42	
No. 3 chamber.....		16	28	

Quantity and Strength of Circulating Acid

	Quantity Fed Per Hour	Strength Fed, Per Cent H_2SO_4	Strength Leaving, Per Cent H_2SO_4
Glover tower			80
Chamber acid....	1,800 lb.	65	..
Nitrous vitriol..	13,000 lb.	80	..
Chamber			
No. 1	600 gal.*	65	65
No. 2	600 gal.	62	62
No. 3	600 gal.	58	58

*Imperial gallons = 720 U. S. gal.

Formulas and Other Data Used

Heat of formation (Thomsen's "Thermochemistry")



Heat of dilution (Thomsen's "Thermochemistry")



Density of burner gases (calculated) =

0.089 lb. per cu.ft. at N.T.P. (0 deg. C., 760 mm.)

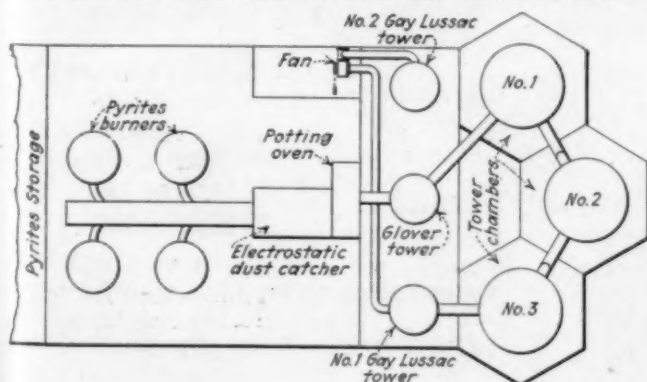
Specific heat of burner gases =

0.24 C.h.u. per lb. (1.8 B.t.u. = C.h.u.)

Note

No account is taken in the calculations in this article of the thermal effect of the reduction and oxidation of nitrous gases. It is assumed that these effects balance and the net result is due to the combination of SO_2 , O, and H_2O .

Ground Plan of the Gaillard-Parrish Plant at Voves, France



CALCULATION OF RESULTS

Data in Table I are used as the basis for computation of heat balances* for each chamber and for the Glover tower. Table II summarizes these results while Table III lists the measure of effectiveness of the surfaces in the various units of the plant in the dissipation of heat of reaction.

GLOVER TOWER

(A) Heat Entering and Generated Within the Tower

1. Sensible heat of gases entering the tower

$$\frac{860 \times 64 \times 350 \times 100}{32 \times 64 \times 7} \times 0.089 \times 0.24 \times 400 = 1,148,100 \text{ C.h.u.}$$

2. Heat generated by the formation of acid in the tower (i.e., 25 per cent of the total acid made)

$$\frac{860 \times 98 \times 53,480 \times 25}{98 \times 32 \times 100} = 359,320 \text{ C.h.u.}$$

3. Heat generated by the dilution of this acid to 80 per cent H_2SO_4

$$(a) \frac{860 \times 98 \times 25}{32 \times 100} = 658 \text{ lb. } \text{H}_2\text{SO}_4$$

$$= 822.5 \text{ lb. 80 per cent } \text{H}_2\text{SO}_4 \text{ or } 658 \text{ lb. } \text{H}_2\text{SO}_4 + 164.5 \text{ lb. } \text{H}_2\text{O}$$

$$(b) \frac{658}{98} \left[\frac{17,860 \left(\frac{164.5 \times 98}{18 \times 658} \right)}{\left(\frac{164.5 \times 98}{18 \times 658} \right) + 1.798} \right] = 51,700 \text{ C.h.u.}$$

$$\text{Total} = 359,320 + 51,700 + 1,148,100 = 1,559,120 \text{ C.h.u.}$$

(B) Heat Absorbed and Dissipated

1. Heat absorbed by acid leaving tower

- (a) 1,800 lb. chamber acid at 65 per cent H_2SO_4 enters the tower at 20 deg. C., and leaves as 1,463 lb. 80 per cent acid at 125 deg. C.

- (b) 13,000 lb. nitrous vitriol enters at 35 deg. C. and leaves at 125 deg. C.

- (c) 822.5 lb. 80 per cent acid is made within the tower and leaves at 125 deg. C.

$$(a) 1,800 \times (125 - 20) \times 0.4 = 75,500 \text{ C.h.u.}$$

$$(b) 13,000 \times (125 - 35) \times 0.4 = 378,000 \text{ C.h.u.}$$

$$(c) 822.5 \times 125 \times 0.4 = 41,125 \text{ C.h.u.}$$

$$\text{Total} = 494,625 \text{ C.h.u.}$$

2. Heat utilized for concentration of chamber acid

$$(a) \text{Differential heat of solution of } 1,800 \times \frac{65}{100}$$

$$= 1,170 \text{ lb. } \text{H}_2\text{SO}_4 + 630 \text{ lb. } \text{H}_2\text{O} \text{ as } 65 \text{ per cent chamber acid concentrated to}$$

$$1,800 \times \frac{65}{80} = 1,463 \text{ lb. 80 per cent acid}$$

$$+ 337 \text{ lb. water}$$

$$\frac{1,170}{98} \left[\frac{17,860 \left(\frac{630 \times 98}{18 \times 1,170} \right)}{\left(\frac{630 \times 98}{18 \times 1,170} \right) + 1.798} \right] -$$

*The author prefers the use of Centigrade temperature and therefore makes his calculations in "Centigrade Heat Units" (C.h.u.). This unit equals 1.8 B.t.u. and is identical with the "Pound Centigrade Unit" (P.c.u.) sometimes used in the United States.—Editor.

This is water
for dilution
What about Formation

$$\left(\frac{17,860 \left(\frac{293 \times 98}{18 \times 1,170} \right)}{\left(\frac{293 \times 98}{18 \times 1,170} \right) + 1.798} \right) = 40,800 \text{ C.h.u.}$$

- (b) Total heat of 337 lb. steam less 164.5 lb. water required by reaction 1(c), above

$$(337 - 164.5) \times 639 = 110,230 \text{ C.h.u.}$$

- (c) Sensible heat of gases leaving tower SO_2 and O_2 utilized for acid formation within the tower

$$= \frac{2 \times 860 \times 64 \times 350 \times 25}{32 \times 64 \times 100} = 4,700 \text{ cu.ft.}$$

at N.T.P.

Total gas volume entering tower

$$= \frac{860 \times 64 \times 350 \times 100}{32 \times 64 \times 7} = 134,370 \text{ cu.ft.}$$

Gases leaving tower (not including steam)

$$= 134,370 - 4,700 = 129,670 \text{ cu.ft. at N.T.P.}$$

$$100 \times 129,670 \times 0.089 \times 0.24 = 276,960 \text{ C.h.u.}$$

- (d) Heat lost by radiation from tower walls (by difference) = 1,559,120 - (494,625 + 110,230 + 40,800 + 276,960) = 636,505 C.h.u.

FIRST CHAMBER

(A) Heat Entering and Generated Within the Chamber

1. Sensible heat of gases entering

$$= 276,960 \text{ C.h.u.}$$

2. Steam heat

$$= 110,230 \text{ C.h.u.}$$

3. Heat of formation of 38 per cent of the total acid made.

$$\frac{860 \times 98 \times 53,480 \times 38}{98 \times 32 \times 100} = 546,070 \text{ C.h.u.}$$

4. Heat of dilution of

$$\frac{860 \times 98 \times 38}{32 \times 100} = 1,001 \text{ lb. } \text{H}_2\text{SO}_4$$

$$\text{to } 1,001 \times \frac{100}{65} = 1,540 \text{ lb. 62 per cent}$$

H_2SO_4

$$\frac{1,001}{98} \left[\frac{17,860 \left(\frac{539 \times 98}{18 \times 1,001} \right)}{\left(\frac{539 \times 98}{18 \times 1,001} \right) + 1.798} \right] = 113,000 \text{ C.h.u.}$$

$$\text{Total} = 276,960 + 110,230 + 546,070 + 113,000 = 1,046,260 \text{ C.h.u.}$$

(B) Heat Removed From Chamber

1. By sensible heat of acid made

$$1,540 \times 58 \times 0.48 = 42,800 \text{ C.h.u.}$$

less (for water entering at 15 deg. C.)

$$\left[539 + \left(1,001 \times \frac{18}{98} \right) \right] 15 = 11,850 \text{ C.h.u.}$$

$$42,800 - 11,850 = 30,950 \text{ C.h.u.}$$

2. By dispersing 600 imp. gal. of

65 per cent H_2SO_4 (1.56 sp.gr.)

$$600 \times 15.6 \times (58 - 16) \times 0.48 = 189,000 \text{ C.h.u.}$$

3. By sensible heat of gases leaving chamber

$$\text{SO}_2 \text{ and } \text{O}_2 \text{ utilized} = \frac{860 \times 2 \times 64 \times 350 \times 38}{32 \times 64 \times 100}$$

$$= 7,150 \text{ cu.ft. at N.T.P.}$$

Gases leaving tower, 129,670 - 7,150

$$= 122,520 \text{ cu.ft. at N.T.P.}$$

$$122,520 \times 52 \times 0.089 \times 0.24$$

$$= 136,090 \text{ C.h.u.}$$

Table II—Summary of Heat Balances

	Glover Tower		No. 1 Chamber		No. 2 Chamber		No. 3 Chamber		Average of Three Chambers Per Cent
	C.h.u.	Per Cent	C.h.u.	Per Cent	C.h.u.	Per Cent	C.h.u.	Per Cent	
Heat entering									
Sensible heat.....	1,148,100	73.6	387,190	37.0	136,090	41.4	80,600	28.6	37.1
Generated.....	411,020	26.4	659,070	63.0	335,650	58.6	211,500	72.4	62.9
Total.....	1,559,120	100.0	1,046,260	100.0	571,740	100.0	292,100	100.0	100.0
Heat leaving									
Removed by acid made.....	494,625	31.7	30,950	2.9	13,340	2.3	3,460	1.2	2.1
Removed by acid dispersed.....			189,000	18.1	116,200	20.3	54,700	18.7	19.0
Removed by concentrating.....	151,030	9.7							
Removed by gases.....	276,960	17.8	136,090	13.0	80,600	14.1	49,300	16.9	14.7
Removed by radiation.....	636,505	40.8	690,220	66.0	361,600	63.3	184,640	63.2	64.2
Total.....	1,559,120	100.0	1,046,260	100.0	571,740	100.0	292,100	100.0	100.0

4. Dissipated from chamber walls

(by difference)

$$1,046,260 - (30,950 + 189,000 + 136,090) = 690,220 \text{ C.h.u.}$$

Calculations for the second and third chambers are exactly comparable.

SECOND CHAMBER

(A) Heat Entering and Generated Within the Chamber

1. Sensible heat, gases entering = 136,090 C.h.u.
2. Heat of formation of 25 per cent of the total acid made = 359,300 C.h.u.
3. Heat of dilution of 659 lb. 100 per cent H_2SO_4 with 404 lb. H_2O = 76,350 C.h.u.

$$\text{Total} = 571,740 \text{ C.h.u.}$$

(B) Heat Removed From Chamber

1. By sensible heat of acid made = 21,220 C.h.u. less 7,880 for water entering at 15 deg. C. = 13,340 C.h.u.
2. By dispersing 600 imp. gal. of 62 per cent acid = 116,200 C.h.u.
3. By sensible heat of 117,820 cu.ft. (at N.T.P.) of gases leaving chamber = 80,600 C.h.u.
4. Dissipated from chamber walls (by difference) = 361,600 C.h.u.

THIRD CHAMBER

(A) Heat Entering and Generated Within the Chamber

1. Sensible heat, gases entering = 80,600 C.h.u.
2. Heat of formation of 12 per cent of total acid made = 172,000 C.h.u.
3. Heat of dilution of 316 lb. 100 per cent H_2SO_4 with 230 lb. H_2O = 39,500 C.h.u.

$$\text{Total} = 292,100 \text{ C.h.u.}$$

(B) Heat Removed From Chamber

1. By sensible heat of acid made = 7,780 C.h.u. less 4,320 for water entering at 15 deg. C. = 3,460 C.h.u.
2. By dispersing 600 imp. gal. of 58 per cent acid = 54,700 C.h.u.
3. By sensible heat of 115,560 cu.ft. (at N.T.P.) of gases leaving chamber = 49,300 C.h.u.
4. Dissipated from chamber walls (by difference) = 184,640 C.h.u.

Table III—Heat Radiation from Glover Tower and Chambers

	Superficial Area, Sq. Ft.	Mean Gas Temp., Deg. C.	Total Radiation, C.h.u.	Radiation, per Sq. Ft. per Hour per Deg. C., C.h.u.
Glover tower.....	1,722	225	636,505	1.64
No. 1 chamber.....	4,672	72	690,220	2.05
No. 2 chamber.....	4,672	41	361,600	1.89
No. 3 chamber.....	4,672	25	184,640	1.59
Average, chambers only				1.85

CONCLUSIONS

In connection with Table II it should be borne in mind that the acid produced by the several chambers varies under certain circumstances, and it is not an easy matter to determine all the data under constant conditions. As the formation of sulphuric acid constitutes the major source of heat, it would be preferable to take the average figures as representing the performance of the Gaillard-Parrish chambers furnished in the summary.

Facts that are evident from consideration of the foregoing data and calculations may now be briefly indicated.

1. Although the temperatures of the gases entering the three Gaillard-Parrish reaction chambers are respectively 100 deg. C., 52 deg. C., and 32 deg. C., the lead walls rarely exceed 68 deg. C., in the first chamber, and are, of course, correspondingly lower in the two other chambers. Experience has shown that this feature of the liquid phase system contributes in a very important way toward preservation of the lead.

2. Of the acid made in the tower chambers under liquid phase conditions, 50.6 per cent is produced in the first chamber, 33.4 per cent in the second, and 16 per cent in the third.

The regeneration of the nitric oxide actually takes place in a reaction chamber where a not inappreciable percentage of acid is being manufactured. Thus the attack on the lead is reduced to a minimum.

3. It will be seen that 19 per cent of the total heat is removed by the dispersion of sulphuric acid in the tower chambers. This performance alone, in the author's opinion, would justify the use of turbo-dispersers.

4. It is known that tower chambers of the type and dimensions of those at Voves, when operated under ordinary circumstances, without any attempt at securing liquid phase conditions, require at least 7 cu.ft. of chamber space per pound of sulphur per 24 hr., if reasonably steady and uniform working is to be obtained. It has already been shown (Table II) that 19 per cent of the heat in the chambers is dissipated by means of the acid dispersed. This represents an advantage of 19 per cent of 7 cu.ft. or 1.33 cu.ft. for this system.

Thus, it would be unreasonable to expect the Voves installation to work under better conditions than 7 cu.ft. minus 1.33 cu.ft. = 5.67 cu.ft., if heat removal were the only factor. Actually, as is shown by the figures furnished, the Voves installation operates at 3.5 cu.ft. of chamber space per pound of sulphur per 24 hr. Hence, the advantage from the liquid phase reaction, *per se*, is 38.2 per cent. Where a Gaillard-Parrish liquid phase plant is correctly proportioned, and well designed, the space-time factor can be reduced by 19.0 per cent + 38.2 per cent = 57.2 per cent total. The author believes it is no exaggeration to say that no other type of void reaction chamber is capable of similar performance.

Making RESEARCH Pay Its Way

An Editor Interviews

THEODORE SWANN

*President, The Swann Corporation,
Birmingham, Ala.*



IT'S NO SECRET that I am neither a chemist nor an engineer. But having been closely concerned with a great many chemical developments in recent years, I have come to have a wholesome respect for research and the part it plays in building new industries. When, of necessity, I have had to watch rather anxiously at times over the balance sheets of some of these new industries, I have had the feeling that our modern accounting practices do a grave injustice to research. Why must we always carry it on our books as an expense? Why, on the other hand can't we capitalize it as an investment to be credited directly with the dividends it earns in developing new products and new processes?

Last month, when we finally perfected a plan to co-ordinate and unify the research and development activities of the various subsidiaries of The Swann Corporation, we decided that we were going to make research pay its own way. Swann Research, Inc. will operate as a separate business. When new products or processes are developed they will be assigned to the other Swann companies on a royalty basis. In that way we shall have at any time a definite accounting of just what our research is worth to us. Likewise the royalties paid to Swann Research, Inc., will provide it with an income commensurate with its own productivity. As long as it continues to produce, its permanence is assured. If, through incompetent effort, practical results are not forthcoming after a reasonable period, then the scale of its operation is automatically curtailed.

In this process of "rationalizing" research, however, we must not lose sight of the fact that research, as its very name implies, is essentially an expedition into an unknown field. Neither its results nor its costs can be predicted with exactness. However, with intelligent planning, with a clear vision of both the immediate and the long range objectives, with proper personnel and direction, research will ultimately bring rich rewards to any industry.

We must also appreciate the fact that research should usually be organized on an entirely different basis than most other forms of business. The army type of organi-

THEODORE SWANN has played an important part in the development of chemical and metallurgical industries in the South. In 1917, when ferro-manganese was sorely needed by the steel industry, he formed the Southern Manganese Company to make the product in an electric furnace from low-grade domestic ores. With the expiration of the war this business vanished, but through its research the company was able to adapt its electric furnace process to the successful manufacture of phosphoric acid. Then the Federal Phosphorus Company was formed by Mr. Swann and his associates, and within a few years the economies of the process and the high purity of its products combined to bring it to the foremost position in its industry.

Since 1922 other subsidiaries have been formed or acquired and the research which is discussed in the accompanying article has carried the Swann interests far into such fields as fertilizers, synthetic organic and textile chemicals.

In addition to being president of the Swann Corporation and its various subsidiaries, Mr. Swann is director of the First National Bank of Anniston, the First National Bank of Birmingham, and the Bankers Mortgage Company of Birmingham. During the war he was an associate member of the United States Naval Consulting Board, and is now a lieutenant colonel in the Ordnance Reserve Corps. He is a member of the American Iron and Steel Institute, American Institute of Mining and Metallurgical Engineers, and associate member of the American Institute of Electrical Engineers.



zation, for example, defeats the object before research starts. An army is a wonderful machine for destruction or for concentrated action requiring neither thought nor initiative except from those in command. Research is essentially creative and constructive. It demands individual effort, resourcefulness, competence and judgment.

Perhaps I can best illustrate further details of the research organization by referring again to our own

plans. The present research staffs of the various companies have been brought together in Swann Research, Inc., which has been capitalized at \$250,000 and will have its principal laboratories at Anniston, Ala., and St. Louis, Mo. This organization will be divided into three groups: (1) Commercial research to handle market surveys, economic investigations of new processes and proposals, plant location, patents, production costs, consumption and the various other factors of the competitive situation. (2) Laboratory research on new processes and products, the improvement of present methods and materials, and the finding of new adaptations and uses. The laboratory must conduct all work of a fundamental and scientific nature establishing the facts and data on which all process steps, materials, yields and recoveries are to be based. (3) The Development Department takes up the problem completed by the laboratory, carrying the new products and processes through pilot plant operation to large scale manufacture.

Something has already been said of the results that may be expected from research. If those that have already been achieved by our various companies are any index of the future, the new research company faces promising prospects. Outstanding in commercial importance was the successful development of the electric furnace process of producing phosphoric acid with ferro-phosphorous as a byproduct. Already that process is being used or has been licensed to be used in Italy, Great Britain and France, while negotiations with a German company are still underway. Aluminous and silicon-carbide abrasives have long been regarded as well established products, but it was necessary for our Research Department completely to develop processes of manufacture in order to obtain the improved quality we desired. The application of spray drying to the calcium and sodium salts of phosphoric acid revealed interesting scientific and commercial possibilities. Another research on phosphate products led to the development of a garden fertilizer of the highest concentration and solubility ever attained. Substantially 100 per cent water soluble, it contains 17 per cent of nitrogen, 33 per cent of P_2O_5 and 17 per cent of K_2O , making a total of 67 per cent of actual plant food.

The most striking of our research developments during the past year have been in the field of synthetic organic chemistry, particularly in the production of diphenyl and its derivatives.

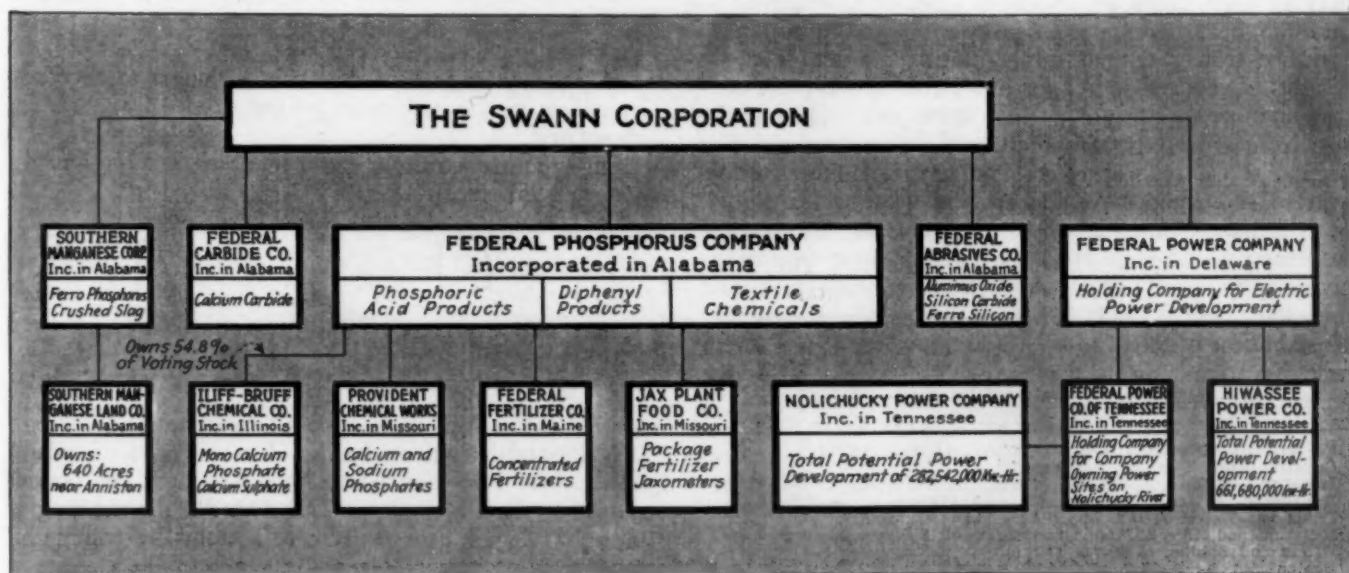
First we perfected a pyrolytic process for making this material from benzene. Never previously had diphenyl been available in sufficient quantity or at a low enough price to permit it to find any commercial use. Then having put this new organic chemical on an economical manufacturing basis, we turned to its derivatives and shortly developed a number of new products of very interesting properties. The chlorinated products, for example, form a series known as the "Aroclors" and these products range from colorless liquids of low viscosity to hard, brittle resins. Some of their properties suggest a great many interesting commercial applications. In all, upward of fifty new products have been developed by research from this one starting material, diphenyl.

I could continue with many other instances of benefits which our companies have derived from research. I could also cite, if I cared to, many cases where negative results have kept us out of making unwise investments. These are sufficient, however, to indicate the high regard I have for research and my sincere desire to see it placed on the highest possible plane of efficiency.



Xylose Becomes Available

FOR the first time, xylose is now available in sufficient quantities to permit experimental research into possible commercial uses. In an effort to find some marketable value in cottonseed hull bran, it was discovered in the laboratory of the U. S. Bureau of Standards that the bran contains .25 to .30 per cent of this rare sugar. A process for extraction of xylose was worked out in the laboratory. In co-operation with the University of Alabama, Alabama Polytechnic Institute, and the Federal Phosphorus Company, a small-scale factory has been erected at Anniston, Ala., to put this laboratory process into semi-commercial production. The factory started operating March 16, 1929. It has produced to date upward of two tons of pure crystalline xylose.



Calculating Heat for Flashing Petroleum Hydrocarbons

By SMITH D. TURNER

and

J. W. HARRELL

Humble Oil & Refining Company
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WITH THE EXCEPTION of boiling characteristics, there probably are no data on the properties of petroleum hydrocarbons as important to the designing engineer as those which enable him to calculate the heat content of oil streams at different temperatures, pressures, and degrees of vaporization. Obviously, the kinds of data that can enter into such calculations are: (a) specific heats of liquids, (b) latent heats of vaporization, and (c) specific heats of vapors. Satisfactory data upon all three are now available.

For the specific heats of liquids, the authors use the results of Fortsch and Whitman¹ in preference to earlier work on the subject.^{2,3} Latent heat data are well correlated by the use of the Hildebrand function.^{4,5,6} A very convenient presentation of such data is that of Wilson and Bahlke,⁷ who give curves of latent heat against pressure for the different paraffin hydrocarbons. The specific heats of petroleum vapors have recently been determined and correlated by Bahlke and Kay.⁸

Even with information at hand from such sources, the problem of determining the heat required to produce a given change of state in a hydrocarbon mixture is not solved. This is true for two reasons: the heat requirement is not independent of the path from initial to final state, and the exact application of the data is not possible along the path of an actual process. The purpose of this paper is to calculate, as exactly as possible, and with the aid of some data not ordinarily available, the heat requirements to produce certain changes of state in hydrocarbon mixtures, and to compare the results with those obtained by certain approximate methods now in use.

That an exact application of the data is impossible may be seen from an example. Let it be required to find the heat necessary to heat an oil at atmospheric pressure from a temperature t_0 until the fraction x_1 , by weight, is vaporized. Vapor and liquid are kept in contact and in equilibrium as in a tube still. During the rise from t_0 to some temperature, t_v , where vaporization begins, the only heat effect is that of adding sensible heat to the liquid. As the specific heat of the liquid, S , is a linear function of the temperature, its average value may be taken at $\frac{1}{2}(t_0 + t_v)$ and the heat required is given by $(t_v - t_0)S_{Ave.}$ At t_v vaporization begins, and thereafter three heat effects occur simultaneously: sensible heat is added to both liquid and vapor and latent heat of vaporization is absorbed. At the point when the temperature t is reached, let

S = specific heat of the liquid
 s = specific heat of the vapor
 L = latent heat of vaporization
 x = weight fraction vaporized
 Q = heat added during vaporization.

When the additional amount dx (see Fig. 1) is vaporized, and the temperature correspondingly rises dt , the sum of these three heat effects is

$$dQ = Ldx + sxdx + S(1 - x)dt \quad (1)$$

This formulation is exact, but to integrate it as it stands would be difficult, for the following reasons:

1. The rate of vaporization with temperature use is not known.

2. Both the temperatures and gravities of the vapor and liquid, upon which their specific heats depend, are continually changing.

3. The latent heat of vaporization is changing.

However, the following simplifying assumptions, none

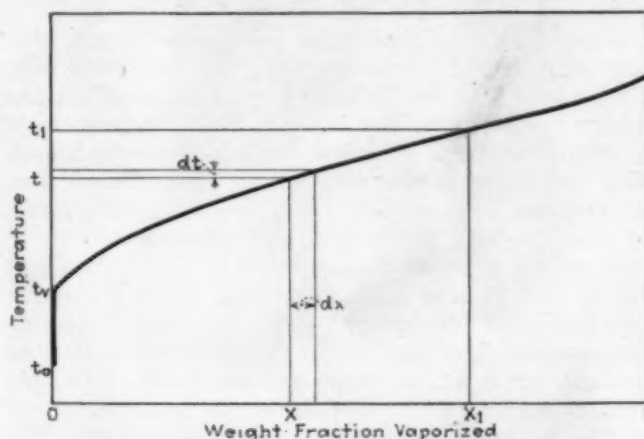


Fig. 1—Graphic Representation of Derivation of Equation 1

of which is at serious variance with observed results, can be made:

1. Flash vaporization, or t vs. x curves are substantially straight lines. Hence $dt = a dx$ where

$$a = \frac{t_1 - t_v}{x_1}$$

2. During vaporization the average gravities of vapor and liquid are those that exist when half the amount, $\frac{x_1}{2}$, has been vaporized.

3. The average values of S and s are those at the above gravities, and at the average temperature of vaporization, $\frac{1}{2}(t_1 + t_v)$.

4. The average heat of vaporization is that corresponding to the molecular weight of the fraction, x_1 , vaporized.

Making the substitution indicated in assumption 1, equation 1 becomes

$$dQ = Ldx + asxdx + aS(1 - x)dx \quad (2)$$

$$\text{Or } Q = \int_0^{x_1} [L + aS - a(S - s)x] dx \quad (3)$$

Regarding L , a , S , and s constants, as indicated above, integration gives

$$Q = (L + aS)x_1 - \frac{1}{2}a(S - s)x_1^2 \quad (4)$$

where Q is the heat added during vaporization.

An illustration will make the above method of calculation clear. It is desired to know the heat per pound required to flash a crude of 27.3 deg. A.P.I., entering a still at 100 deg. F., to 40 per cent bottoms by volume at atmospheric pressure. The following data are available:

¹ Fortsch and Whitman, *J. Ind. Eng. Chem.*, 14, 485 (1922).
² Eckhart, *Mech. Eng.*, 47, 535 (1925).
³ Leslie and Geniesse, *J. Ind. Eng. Chem.*, 16, 582 (1924).
⁴ Hildebrand, *J. Am. Chem. Soc.*, 37, 970 (1915).
⁵ Lewis and Weber, *J. Ind. Eng. Chem.*, 14, 485 (1922).
⁶ McAdams and Morrell, *Ibid.*, 16, 375 (1924).
⁷ Wilson and Bahlke, *Ibid.*, 16, 116 (1924).
⁸ Bahlke and Kay, *Ibid.*, 21, 942 (1929).

(a) The flash (t vs. x) curve is substantially linear, with the initial point at 250 deg. F. and 60 per cent off at 710 deg. F.

(b) A curve of the molecular weight of the vaporized portion shows 172 at 60 per cent, and 240 at 100 per cent vaporized.

(c) A curve of the degrees A.P.I. of the vaporized portion shows 50.0 deg. at 30 per cent and 38.0 deg. at 60 per cent vaporized.

In heating the oil to the vaporization point the average temperature is 175 deg. F., and from the equation of Fortsch and Whitman:¹

$$\text{Specific Heat of Liquid} = \frac{(t + 670)(2.10 - \text{Sp.Gr. at 60 deg.})}{2,030}$$

The specific heat equals 0.503, and the heat required is $(0.503)(250 - 100) = 75.5$ B.t.u. per pound.

From the gravities of the charge and distillate the weight fraction corresponding to 60 per cent by volume vaporized is found to be $x_1 = 0.562$. The gravity of the bottoms at 30 per cent off is found to be 19.1 deg. A.P.I., and from this figure and the average temperature of $\frac{1}{2}(710 + 250)$, the average value of S during vaporization is found to be 0.656. For 38.0 deg. A.P.I. vapor, the equation of Bahlke and Kay⁸

$$\text{Specific Heat of Vapor} = \frac{(t + 670)(4.00 - \text{Sp.Gr. at 60 deg.})}{6,450}$$

gives the average value of s over this range as 0.564. The slope of the flash curve is

$$a = \frac{t_1 - t_v}{x_1} = \frac{710 - 250}{0.562} = 818$$

The latent heat of vaporization, at atmospheric pressure, corresponding to the molecular weight of 172 is 112. Substituting in equation 4 the following: $S = 0.656$, $s = 0.564$, $x_1 = 0.562$, $L = 112$, and $a = 818$ gives

$$Q = [(112 + 537)(0.562)] - [(0.5)(818)(0.656 - 0.564)(0.562)^2] = 352.$$

The total heat required is then $352 + 76 = 428$ B.t.u. per pound.

In the above calculation a refinement was made in allowing for the change in gravities of vapor and liquid. As one increases, the other decreases, and the two effects should nearly offset each other. In the following approximation the properties of the liquid and vapor are taken as constant, and as those of the 27.3 deg. A.P.I. charge. This assumption gives $S = 0.685$, $s = 0.554$ and $L = 95$, the other quantities remaining the same. Equation 4 gives $Q = 351$, and the total heat required is $351 + 76 = 427$, as compared with 428 B.t.u. per pound by the more exact method.

In the absence of data on the specific heat of vapors it has been a rather general practice to estimate the heat required by simply adding the heat necessary to heat the oil from the initial to the final temperature, (t_0 to t_1), to the latent heat. This assumes that the vaporization all takes place at the highest temperature. The average specific heat over the whole range for the 27.3 deg. A.P.I. stock is found to be 0.640 so the heat required is

$$(0.640)(710 - 100) + (0.562)(95) = 443 \text{ B.t.u. per pound.}$$

Similarly, it may be assumed that the vaporization all takes place at the start, in which case we add the heat of vaporization, and the sensible heat to raise x_1 lb. of

vapor and $(1 - x_1)$ lb. of liquid over the whole temperature range. The specific heat of the vapor is found to be 0.518, so the heat required is

$$(0.562)(95) + (0.562)(710 - 100)(0.518) + (0.438)(710 - 100)(0.640) = 401 \text{ B.t.u. per pound.}$$

The above four methods of calculation were applied to two other oils on which the necessary data were available: a lighter crude of 35.9 deg. A.P.I. and a gasoline of 51.6 deg. A.P.I. The results of this work are summarized in Table I.

In all probability our specific heat data are not good to more than 1 or 2 per cent. From this, and the results of the above calculations, we may conclude:

(1) The laborious refinements used in Method 1 are not worth while, as they are checked by Method 2 well within the accuracy of the data.

(2) Except for the roughest calculations, Method 2 should be used in preference to such approximations as Methods 3 and 4.

Table I—Comparison of Methods of Calculating Heat Absorption

Method of Calculation	B.t.u. per Pound		
	A	B	C
1. Most exact method using equation 4.....	428	399	193
2. As above, but taking properties of vapor and liquid as those of charge stock.....	427	397	194
3. Assuming liquid heated to highest temperature and then vaporized.....	443	417	201
4. Assuming vaporization at lowest temperature, and vapor and liquid then heated to highest temperature.....	401	369	181

Benzol Production May Become Future Refinery Function

RECENT work on the production of benzol from refinery gases at the Massachusetts Institute of Technology is described by the *Oil and Gas Journal*. Results obtained so far indicate that approximately 0.2 gal. of benzol can be made from 1,000 cu.ft. of methane gas treated.

The process involves cracking and polymerization of the gases at temperatures of 1,150 deg. C. or higher. Gas passed through a quartz tube at the temperature of 1,150 deg., and at a velocity to limit contact with the tube to 0.6 second, gave a benzol yield of 0.2 gal. per 1,000 cu.ft., indicating a conversion percentage of 4.8. It was found that the use of reduced pressure in the tube affected the yield only very slightly. At the velocities studied, temperature above that indicated resulted in rapid increase in the production of hydrogen and carbon. The temperature of 1,150 deg. therefore was taken as the commercial limit for the process.

It was found that time of contact with the heated tube had a decided effect on the yield. As a consequence, work is now being conducted on the use of the electric arc instead of the heated tube. It has been demonstrated that the amount of degradation of the products is considerably reduced by the rapid passage through the arc flame and by the addition of hydrogen to the gases. When an amount of hydrogen double the volume of the methane was added to the methane before passage through the arc, the yield of acetylene, the primary product of the cracking, was 51 per cent plus 15 per cent of carbon, as compared with 13 per cent of acetylene and 25 per cent of carbon when hydrogen was omitted.

SPRAY DRYING LATEX

The Hopkinson method for the spray drying of rubber has the advantage of retaining in the rubber many of the constituents of the latex that are beneficial

By HENDRICK DE LEEUW

SEVERAL years ago Ernest Hopkinson, of the United States Rubber Company, undertook the development of a more simple process for the production of crude rubber. The spray-drying process which he developed was not only simpler but the rubber produced had qualities that the "smoked sheet" and "crepe" did not possess. This process is used exclusively on the large plantations of the U. S. Plantations Company in Sumatra and by the Anglo-Dutch Plantations Company in Java for the drying of rubber, and a somewhat similar process is used in Germany for the drying of various colloidal liquids such as milk. An increasing interest in the use of this type of crude rubber in England, on the Continent, and in America makes appropriate a review of the facts regarding sprayed rubber and a description of the process.

In order to understand better the technique involved in the drying of the rubber particles it might be advisable to review briefly the properties and composition of latex. Hevea latex, one of the most complicated of fluids, on microscopic examination appears to be of a milky nature, consisting of a number of minute rubber globules suspended in a watery liquid. These globules are so small—their diameter varying from 0.0005 to 0.003 mm.—that the number of the particles in a given volume of latex is enormous. One gallon of ordinary latex contains from 200 to 250 billion globules, which are constantly in vibration with a Brownian movement. Some scientists contend that latex is an emulsion while others claim that it is a suspension. On adding a coagulant to latex under a microscope, the vibrations and movements are seen to cease, the particles gradually grouping themselves into clots.

Latex is composed, besides water and rubber, of various constituents such as sugar, proteins, salts and resinous substances. Non-rubber constituents have an important influence on the properties of the rubber, on its cure and viscosity. While precise data concerning latex and its

constituents are rare, Table I gives some idea of the constituents.

When latex has been exposed to the atmosphere a short time the particles of rubber commence to coagulate. If the coagulation was allowed to form, the rubber would be difficult to wash free of dirt, bark, and other impurities. To prevent this premature coagulation of the rubber, anti-coagulants are added to the cups into which the latex flows from the cuts in the trees. For this purpose

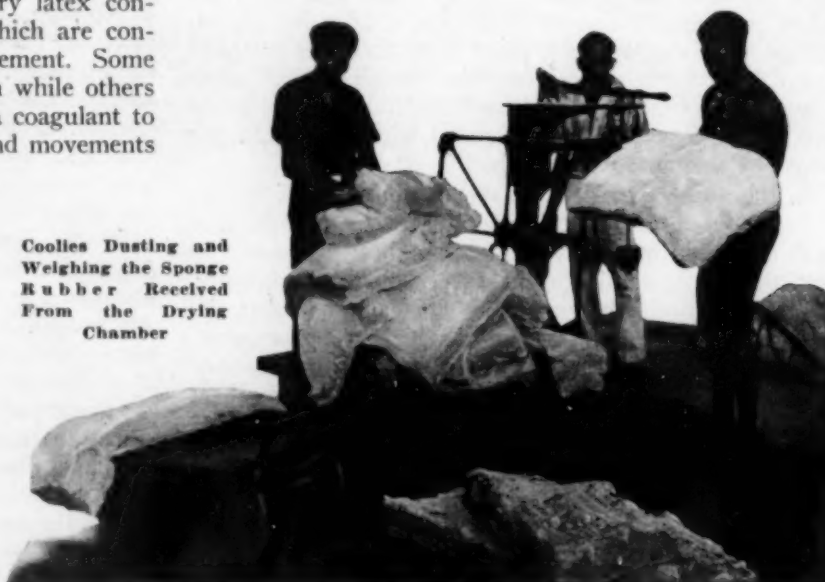
Table I—Approximate Composition of Latex

	Per Cent in Latex	Per Cent in Rubber As Per Cent Dry Rubber
Rubber hydrocarbon.....	28	92-94
Commercial rubber.....	30	100
Total solids.....	33-34	98.8-99.7
Mineral substances (ash).....	0.3-0.7	0.15-0.45
Protein.....	1-2	2.5-3.5
Resins (sol. in acetone).....	.....	2.5-3.2
Quebrachite.....	1-2	.....
Reducing sugar.....	0.15-0.35	.....

ammonia generally is used. Other agents that also are used to preserve its fluidity and state of suspension are formalin and powdered washing soda.

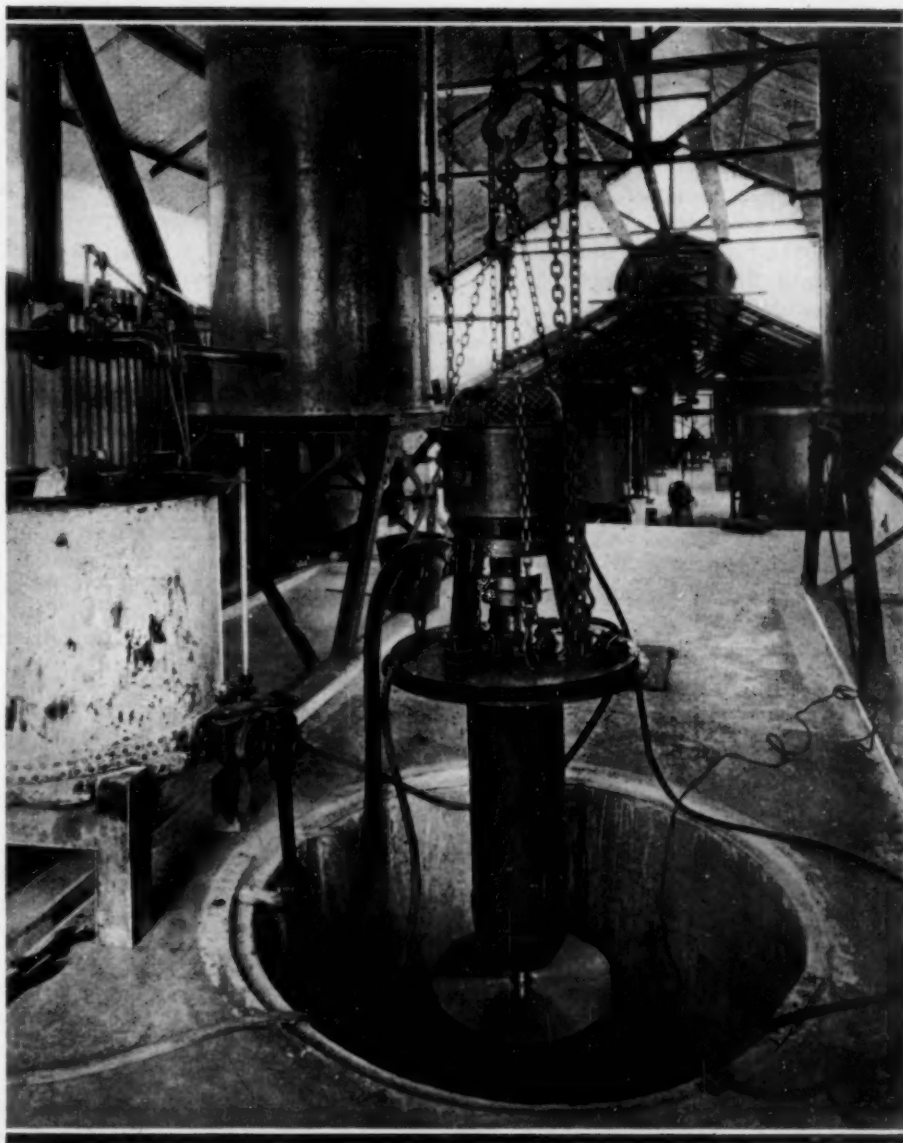
The preparation of crepe or smoked sheets requires the coagulation of the rubber in the latex. Coagulation

Cooling, Dusting and Weighing the Sponge Rubber Received From the Drying Chamber



IN SUMATRA

View of several of the spray drying units on a kebon of the Holland-Amerikaansche Plantage Maatschappij at Boenoet, on the east coast of Sumatra. In the foreground the rotor is seen suspended from a block and tackle at the top of the building. The 18-in. disk which atomizes the latex is at the lower end of the spraying apparatus. In the background are several additional spraying units.



can be accomplished mechanically, physically or chemically. When it commences the rubber separates in one coherent mass which at first fills the whole volume occupied by the latex, but gradually contracts, leaving a clear serum. The bulk of plantation rubber is coagulated by means of acetic acid, as it produces a good coherent workable mass from which a high grade of rubber can be obtained. It gives a satisfactory coagulation with either dilute or undiluted latex of varying composition and it is not detrimental to the quality of the rubber. Native growers, however, universally use alum, obtainable everywhere as a cheap powder and therefore a convenient medium.

The preparation of the rubber can be regarded as a drying process or a separation of the caoutchouc materia, the latex, from the useless materia, the serum. While in practice about 35-40 per cent of the latex is of value, a method had to be developed to segregate the valuable

from the valueless constituents by an economical procedure. Various methods have been patented in the course of years: i.e., filtration of a colloidal solvent in ordinary practical filters, centrifugation, spreading the latex in a thin layer, all expedients to obtain great superficies enabling the water to evaporate. Further, there were the theories of Wickham, Schadt and Kerkbosch, and finally the latex-spraying method developed by Dr. Hopkinson. Quick drying is of the utmost importance and the question always has been how to get good air-dried rubber without unfavorable internal or external effects.

Latex is transported by coolies, who tap the trees and collect it, to the kebon (the plantation fields where the

rubber trees are grown), where it is stored in tanks of 800 gal. capacities and a minimum quantity of stabilizer is added to prevent premature coagulation. Coolies usually are paid after the rubber content of the latex has been ascertained and payment is effected every day. On native rubber plantations the coolies receive part of the rubber as payment; therefore, the more latex they gather from each tree the better will be the payment for the day. This method of payment, however, tends to harm the trees by overlapping.

Latex is conveyed in tanks drawn by Ford motor cars or narrow-gage railroads from the field stations to the central spray plant at Boenoet. On arrival at the central plant the tank cars of latex are first weighed and the contents sampled. The latex is then transferred to large steel storage tanks holding from 40,000 to 50,000 gal., and thoroughly mixed.

THE method for the spray drying of rubber consists of atomizing latex by pouring it upon a disk installed at the top of a drying chamber, rotating at a high speed. Air heated to 350 deg. F. intermingles with the particles of latex, drying them without raising the temperature to a point which would be detrimental to the rubber. The falling dried materia resemble snowflakes. The mass of rubber is removed at intervals and pressed.

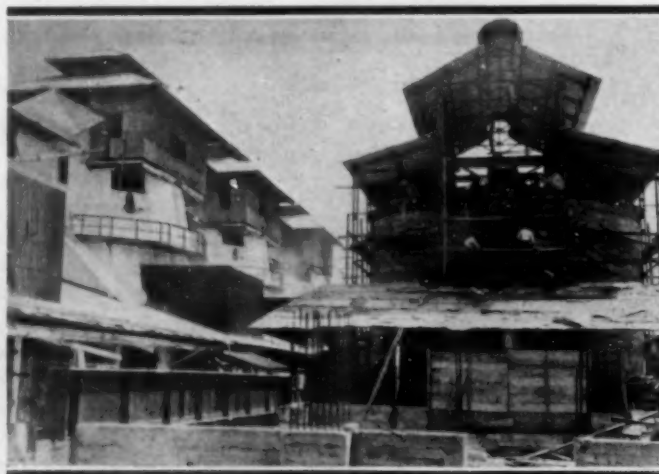
A spray unit consists of a tank holding several hundred gallons, the spraying apparatus and the drying chamber. Latex is forced through a rubber hose from the tank to the top of the cone, where it is led to the spray rotor which atomizes it, the fineness of the atomization being controlled by the speed of the rotation of the electrically driven 18-in. disk. The spraying apparatus is shaped like an inverted truncated cone. It reaches a diameter of 30 ft. and is covered with steel plates. The heated air is produced by an oil-burning furnace located near the unit. The hot air is forced to the top of the cone through insulated pipe.

The drying chamber or lower compartment is a concrete-walled room, 30 ft. square and 30 ft. high. At the bottom there is a series of parallel floors mounted on rollers. These floors can be withdrawn one at a time so that the dried rubber which has accumulated on them can be removed.

Rubber as it comes from the drying room is in a spongy mass. It is pressed into a more compact mass by hydraulic presses, baled in heavy burlap and shipped to Belawan, the seaport of Deli.

The drying units on the plantations of the United States Rubber Company have a capacity of 250 gal. of latex an hour, or a yield of nearly two tons of rubber a day. The labor is done by Chinese coolies. They are very efficient laborers; thousands of them are imported under contract each year.

United States Plantations Company's
Plant at Boenoet



Next to the whites, the Chinese are the most reliable and energetic laborers obtainable.

Air dried crepe rubber contains from 0.3 to 1 per cent of moisture. While the moisture content of air-dried smoke sheet is somewhat higher under normal conditions than crepe (in the tropics usually 0.8 per cent and in the cooler climates of Europe and America about 0.6 per cent), sprayed rubber has a moisture content of approximately 0.3 per cent.

Para rubber from Brazil has been accepted for years as the standard in crude rubber performance. An early criticism of the output from the Eastern plantations was its relatively low strength—its non-uniformity in vulcanization performance. Investigations of the processes of smoked sheet and crepe production disclosed many factors on the estates not susceptible of control in the small unit handlings necessarily involved in the required procedure of making these so-called market grades. And it was in an endeavor to eliminate or at least modify the quality variations thus produced that the spray-rubber process was developed. The first latex dried on a commercial scale by the new process was made in Sumatra about ten years ago.

THE rubber prepared in this manner differs from the standard grades in that it contains some of the constituents of the latex that are natural accelerators and anti-oxidants, so that the time required for curing the rubber is shorter and the vulcanized product resists aging better than do market grades. Vulcanizing properties are remarkably uniform both as regards curing time and uniform tensile properties due to the storing of large quantities of latex prior to spraying. Optimum tensile strength, as given by Dr. Hopkinson, of 20 different lots of rubber in a ten per cent sulphur stock by comparison with the same number of tests of sheet crepe and para gave the following results:

	Optimum Tensile Strength (Pounds per Square Inch)
Sprayed.....	3,580
Smoked sheet.....	5,250
Pale crepe.....	3,220
Para.....	3,050

In the manufacture of market grades there are other variables now recognized as serious, so far as crude rubber quality is concerned, and also as unavoidable under the methods of converting the coagulated rubber in the market grades, either smoked or creped. Among these are the small units of latex, the coagulants used, the hand

manipulation of the sheets and the variables involved in the milling. Besides these variables there is the injury that results to the rubber particles through the mechanical mauling which they receive. All these factors are eliminated in spraying latex.

Variety Marks Subjects at C.G.M.A. Meeting

Liquefied Petroleum Gases Hold Chief Interest for Chemical Engineers

IN HIS OPENING address before the 17th annual meeting of the Compressed Gas Manufacturers' Association held on Jan. 28 in New York, President H. M. Hooker remarked that the past year has shown a decided increase in the quantity of compressed gases manufactured, as well as improvement in the safety of manufacturing and handling methods. Observations of the ten speakers who followed him bore out these conclusions from widely varying viewpoints.

Papers ranged from the subject of under-water cutting of steel with the oxygen torch, to the matter of containers for transportation of ladings under pressure. Those papers of particular interest to chemical engineers are briefly summarized below:

HELIUM

E. G. Luening, of the Helium Company, discussed the properties of helium. Its light weight, very high thermal conductivity, low solubility in water, and complete inertness, are the most notable of these properties. The author referred to possible use of helium in connection with grinding and grading of flammable materials, use in diving and caisson work, in heating and refrigerating, and in the melting of metals to prevent the development of blowholes. Recent work has shown the value of helium in food preservation, offering food manufacturers the opportunity of storing surplus production for considerable periods in an atmosphere of helium.

Mr. Luening indicated that the supplies of helium now in sight are substantial. Explorations of the company have brought to light eight major pools, indicating a reserve of over one billion cubic feet of gas. A pool recently located in southeast Colorado contains 8 per cent helium, the highest concentration so far discovered. Plant for the working of this field has just been installed.

LIQUEFIED PETROLEUM GASES

According to W. B. Campbell, of the Philfuels Company, Detroit, who read a paper on liquefied petroleum gases, one authority has estimated the consumption of these products at more than 15 million gallons in 1929. Pintsch gas and later Blaugas were the forerunners of the present liquefied petroleum gas industry. The industry in its present form is closely connected with the manufacture of natural gasoline. "Wet gas," as it comes from the well, usually consists of methane, ethane, and a mixture of other hydrocarbons commonly referred to as the natural gasoline series. As the gas is heavily laden with vapor when taken from the well, it is first compressed and passed through condenser coils, where a certain amount of liquefaction occurs. The liquid portion flows to storage tanks. The remaining gases are conducted to absorption towers where they are brought into contact with a suitable absorbing medium, usually mineral seal oil. The remainder of the commercially liquefiable hydrocarbons is absorbed, leaving the methane and ethane to be distributed as natural gas.

The mineral seal oil is then stripped of its gasoline,



Pantex Plant of Phillips Petroleum Company, Showing Natural Gasoline Plant in Foreground, Where Liquefied Petroleum Gases Are Prepared

cooled and returned to the absorption system. The gasoline vapors are condensed from the stripping operation and added to the product of the compression stage, forming the total make of the plant. Before this product is sold to the refiners as commercial natural gasoline, it usually is treated for the removal of propane and a variable part of the butanes. This is done because the lighter fractions of natural gasoline are no longer in great demand for blending with refinery gasoline, since the refining industry is producing the greater part of its requirements in connection with oil-cracking operations. The situation seems to promise a continuing ample supply of light fractions for the liquefied petroleum industry, since natural gasoline production for 1929 was over two billion gallons, an increase of one-eighth over 1928.

Improvement in methods of rectification and fractionating has kept pace with the need, and permits extremely close separation of the commercial grades of propane, butanes, pentanes, hexanes and heptanes from natural gasoline. Propane, butanes and mixtures of these, together with two grades of commercial pentanes and three special solvent grades, are now commercially available. These products present initial boiling points ranging from -45 to 120 deg. F., and final boiling points from -40 to 300 deg. F.

Propane and butanes, with which this paper was chiefly concerned, have been developed for fuel purposes in three principal directions:

1. *Domestic*—Liquefied propane is the predominant "bottled" gas used for domestic purposes. This is due principally to its freedom from vaporization difficulties at extremely low temperatures. It is estimated that there are fully 100,000 domestic consumers of "bottled" propane at present, an increase of 100 per cent over 1928. There are five or six large, well-known manufacturing and marketing companies with more than 30 wholesale regional distributors now in this field.

Use of propane for the development of markets beyond their mains is beginning to receive the attention of many gas utility companies. This is believed to be an effective method of preserving the gas field against the encroachment of electricity. In view of the fact that the average domestic consumer uses approximately 100 gal. of liquefied petroleum gases per year, this outlet (estimated at more than 10,000,000 gal. for 1930) promises to constitute a substantial part of the total market.

2. *Industrial*—Commercial butane during the past year found wide application in industrial heating, particularly in connection with metallurgical and heat-treating operations. Japanning, frit smelting, glass manufacture and allied uses also accounted for a considerable amount. Due to its cleanliness, freedom from sulphur contamination, constant thermal value, and constant specific gravity, this fuel has been making an increased bid for use where accurate control of furnace temperatures and atmospheres is necessary.

There has been interest in the "stand-by" application of commercial butane in industrial plants where natural gas is used. In the event of natural gas failure, the auxiliary supply may be quickly thrown onto the line.

In view of the fact that commercial butane compares favorably in cost with manufactured gas, interest in its production is rapidly increasing. In 1928, only one manufacturer was actively



Butane Storage Tanks, Louisville Gas & Electric Company

engaged in its marketing for industrial purposes. This company increased its shipments seven times in 1929, while several other large natural gasoline manufacturers entered the liquefied petroleum gas field.

3. *Utility*—The third principal use for commercial butane, in connection with the manufacture of gas by gas utilities, is perhaps the most important. At the beginning of 1929, only one plant was producing butane-air carbureted gas. At the close of the year, 16 more were either in operation, under construction or contracted for. The first installation of this type, located at Linton, Ind., has been in continuous operation for practically two years.

The process used at this plant is known as the Philfuels process of gas manufacture. Its purpose is the supplying of gas to communities hitherto considered too small for service from central gas companies. As the investment for a plant to carbureted butane is only a fraction of that required for a water-gas plant, such an arrangement seems logical in the 700 odd towns of 3,000 or more population which do not have regular gas service.

In this process, butane is received at the plant in tank cars and transferred under pressure to storage. Liquid butane is passed through a vaporizer, where it is heated, vaporized and then mixed with air to the desired calorific value in a proportioning machine. The gas may then be piped to low- or high-pressure storage, or directly into the mains.

Another method for serving communities such as those mentioned above is called the "undiluted propane" system of distribution. Propane vapor is piped directly from the top of the liquid storage tanks to the customers' appliances. The capital requirement in this case is even lower than in that for the Philfuels system.

Liquefied petroleum gas is now being used by the several gas companies in the recarburetion of gas which has lost in calorific value due to condensation in high-pressure gas transmission lines. Propane, butanes and pentanes, depending upon local operating conditions, have all been used successfully. At the same time, commercial butane is being used increasingly as a medium for the cold enrichment of water gas. The initial cold-carburetion installation, made at the plant of the United Power & Light Company, Davenport, Iowa, has been in operation for about two years. About 1½ million cubic feet of blue water gas is carbureted daily with butane as the sole enriching medium. Two other installations were made during 1929. These installations have indicated a large capital saving over gas-oil carburetion equipment, as well as high thermal efficiency, automatic control and extreme flexibility to meet all load conditions. By producing a greater amount of decreased-calorific-value water gas, the over-all capacity of the gas set may be considerably increased when the deficiency is met by butane enrichment.

Commercial butane, as a means of meeting peak loads in the gas plant, is also under consideration by gas utility companies. The Louisville (Ky.) Gas & Electric Company has installed for peak load operation ten vertical 15,000-gal. butane storage tanks having an equivalent capacity in 550 B.t.u. gas of 29,992,000 cu.ft. The investment in this installation, approximately \$37,500, was very much less than additional plant capacity of the ordinary type would have cost.

CYLINDER TESTING

A discussion of the present state of gas-cylinder testing formed the subject of a paper presented by F. Eder, of Robert W. Hunt & Company. The paper described the results of an investigation which is being conducted to determine the characteristics of expansion of high-pressure gas cylinders, to determine methods for such testing, and to derive a theory covering the observations. A number of cylinders were carefully tested by an in-

genious method in which the cylinder was placed under hydrostatic pressure while in a closed water jacket to which a burette was attached. Any expansion of the cylinder causes the water level to rise in the burette, thus giving an extremely accurate measure of volumetric expansion.

As a result of this research, relations between the effective wall thickness and the elastic expansion of various cylinders were determined. The method used also proved valuable in determining the elastic limit of cylinders, as well as the ratio of total to permanent expansion. The investigation has given rise to the belief on the part of the author that the 10 per cent ratio permitted by the I.C.C. requirements could be safely increased.

PRESSURE TANK CARS

Victor Willoughby, of the American Car & Foundry Company, summarized a large number of specifications on transportation equipment for ladings under pressure. He pointed out that a large list of commodities which are not within the category of explosives or dangerous articles, as defined and regulated by the I.C.C., may be transferred in tanks which do not meet all of the I.C.C. requirements. However, these cars must be up to the standard required by the A.R.A. for cars acceptable in interchange. Cars having tanks of special design, to be used for experimental purposes, must have the proper approval of the A.R.A. Tank Car Committee.

The I.C.C. specification 103 is the base specification for tanks. It covers non-insulated, riveted tanks of open-hearth steel, and is primarily for use on cars for the transportation of petroleum products. It is designed for a minimum bursting pressure of 300 lb. per square inch, a test pressure of 60 lb., and a popping pressure of 25 lb. When used for corrosive liquids this tank must have, instead of a safety valve, a frangible disk which will rupture at a pressure not higher than 30 lb. This tank is modified in I.C.C. tanks 103A, 103B and 103C, for corrosive liquids to be transported in steel, rubber linings and tanks of other metals, respectively. I.C.C. 104 is an insulated tank having the same bursting pressure as 103. According to the author, regulations are being revised to permit the transportation of ladings in which the vapor pressure at 100 deg. F. does not exceed 40 lb. absolute in summer, or 45 lb. in winter. I.C.C. 104A is similar except that it is designed for a maximum popping pressure of 75 lb. per square inch. I.C.C. 105A specifications cover forge-welded tanks, for test-pressures from 300 to 600 lb., with permissible vapor pressures at 105 deg. F. of from 225 to 450 lb. These four cars of the I.C.C. 105A variety are all insulated and all call for popping pressure not more than three-quarters of the test pressure.

The I.C.C. 106A specification comprises tanks of the multiple unit type. These tanks are not insulated, have test pressures of 500 and 800 lb. and permissible vapor pressure ladings of three-quarters of the test pressure, at 130 deg. F. For still higher pressure, I.C.C. 107A3,350, the so-called "helium" car, using hollow forged or drawn containers, provides for a test pressure of 3,350 lb. and a permissible gas pressure at 130 deg. F. of three-quarters of the test pressure. It is understood that the Navy has two cars of this type, and the Army one. Gas is shipped in the cars at about 2,000-lb. pressure, making the capacity about 200,000 cu.ft. of free helium gas. These cars use three horizontal cylinders of slightly over 1,500 cu.ft. total capacity.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest



Furnace Methods for Phosphate Production

To the Editor of *Chem. & Met.*:

Sir:—In reading the last section of the article entitled, "Phosphates Record Changing Conditions," in the January issue of *Chem. & Met.*, the writer found a very fine distinction drawn between the so-called fuel-fired furnace method of producing phosphoric acid and the blast-furnace method. In the opinion of the writer such a distinction is not justified, for, irrespective of the fuel used or the method of introducing it into the furnace, the basic principle of the fuel-fired process is essentially the same.

This principle is to utilize *directly* the heat produced from the combustion of fuel to raise the temperature of a suitable mixture of phosphate mineral, a flux, and a reducing agent to the point where the bulk of the phosphate is reduced to elementary phosphorus and a molten slag is obtained, preheated air being employed to economize in fuel and give the desired temperature.

The electric-furnace method of producing phosphoric acid, while based on the same chemical principles, is however a separate and distinct process, for the original source of energy, whether it be fuel or falling water, is converted into mechanical energy, which in turn is changed into electricity, transmitted, and finally transformed into heat and applied to the furnace charge. Moreover, since the heating of the phosphate mixture is not brought about by the direct combustion of fuel, the evolved phosphorus is not greatly diluted with large volumes of nitrogen and carbon monoxide gas, as is the case in the fuel-furnace process.

It was the wide difference in the cost of the thermal unit furnished by fuel and by electric energy which led the writer ten years ago to undertake investigations on the feasibility of using fuel for producing phosphoric acid, in lieu of the electric arc. The results of these investigations have been published in a number of papers, as well as in a government bulletin on the subject. It is true that in most of the earlier experiments, fuel oil was used as the heating agent, but coke also was charged into the top of the furnace with the phosphatic material, furnishing part of the heat energy in a number of experiments, and was the sole fuel used in some of the later work.

When the writer left the government service to help develop the process on a commercial scale, he recommended the use of solid fuel and in most of the work subsequently conducted, no oil has been employed. While for obvious reasons publicity has not been given to the commercial development of the fuel furnace process, the distinction drawn between the work which the United States Department of Agriculture is now carrying on and that which industry has been successfully practicing is not warranted by the facts. In the work on the oil-fired furnace for the production of phosphoric acid, conducted by the writer at Arlington, Va., this furnace

was gas tight and preheated air was introduced through the tuyères along with oil. This meant that all gases produced were forced through the furnace shaft containing the downcoming charge of briquets and reducing agent and therefore its operation was essentially along the lines of the blast furnace.

While the writer has always maintained that the fuel furnace process holds greater commercial possibilities than the electric process, he cannot but feel that the forecast of Royster and Turrentine that P_2O_5 will, or can, be produced by this method at a cost of \$16 per ton is premature, to say the least.

Industry will unquestionably welcome any constructive experimental work along these lines which the government may see fit to carry on, but such a prediction of the ultimate cost of producing P_2O_5 even though based largely on theory, appears rather unfortunate at this time, as it might well cause undue optimism and encourage developments under conditions which would result in failure.

WILLIAM H. WAGGAMAN.

Assistant to the President,
Coronet Phosphate Company,
Pembroke, Fla.

Note:—The furnace classification referred to by Mr. Waggaman was largely that made by *Chem. & Met.* on the basis of mechanical distinctions between oil under-firing and simple coke heating of the shaft furnace. Mr. Waggaman's comment as to the chemical identity of the two systems is fully justified. It appears, therefore, that the major issue which really deserves consideration is merely how optimistic one should be with respect to probable future costs of phosphoric acid. Fine distinctions in classification are, of course, a mere technical convenience and probably not of prime importance in estimating costs.—Editor.

* * * *

Comparative Economies of Coke and Electric Furnace

To Editor of *Chem. & Met.*:

Sir:—The comments of August Kochs in the December issue of *Chem. & Met.* on certain comparative figures in my article "Electrothermal Production of Phosphoric Acid" call for further explanation.

First, Mr. Kochs raises a question as to the derivation of the figure of 3.085 lb. C (as coke) per pound of P_2O_5 in acid product as the minimum fuel requirement in blast-furnace phosphate smelting. This figure was derived from the theoretical energy required per pound of P_2O_5 , shown in Table II of the article, but applicable in any thermal process. The corresponding energy requirement, through coke burned under standard blast-furnace conditions, must be based on the same raw materials for both cases. In order to develop a factor to serve as a basis for calculating the extraneous heat required for the reactions involved, we first calculate the heat derivable from a pound of carbon burned under blast-furnace conditions as follows:

Assuming a blast temperature of 500 deg. C.:

1 lb. C requires for combustion	
O = 1.33 lb. x 500 [2104 + .0000104 (500)] =	143 P.e.u.
N = 4.46 lb. x 500 [2405 + .0000214 (500)] =	558 P.e.u.
Heat carried in by air per lb. C. =	701 P.e.u.
1 lb. C to CO evolves =	2,430 P.e.u.
Heat delivered to furnace per lb. C burned with air at 500 deg. C. =	3,131 P.e.u.
Heat carried out by gases from combustion of 1 lb. C with air at assumed gas temperature of 400 deg. C. is 6.79 lb. CO + N x 400 (0.25) =	679 P.e.u.
Net heat derivable from 1 lb. C. =	2,452 P.e.u.
From Table II in the article the net theoretical energy required per lb. P ₂ O ₅ in the charge is	3,805 P.e.u.
Corresponding energy to be derived from carbon burned under above condition is, then 3,805 ÷ 2,452 =	1.551 lb. C
However, from blast-furnace thermal balances we find that the thermal efficiency of energy transmitted to the materials therein is represented by factor	0.628
Therefore, the net heat required per pound P ₂ O ₅ demands 1.551 ÷ .628 =	2.468 lb. C
With an assumed recovery of 80 per cent of the P ₂ O ₅ from the charge in the resulting acid, the C per pound P ₂ O ₅ in acid is 2.468 ÷ .80 =	3.085 lb. C

The recovery factor of 80 per cent in the blast furnace versus 87 per cent in the electric furnace is assumed on account of the fact that the P₂O₅ must be extracted from at least seven times the volume of gases in the former than in the latter case.

Second, Mr. Kochs compares the relative heat yields from coke in the blast furnace to electrical energy in the electric furnace. He, however, assumes that 90 per cent carbon content coke will yield 3954 B.t.u. (2252 P.e.u.) in the thermal transfer in the phosphate smelting operation. This would be true if the blast-furnace heat transfer to its contents were 100 per cent efficient. We believe the factor of 0.628 taken above is more nearly correct, and that a consumption of 3.085 lb. carbon per pound P₂O₅ in acid is about the best that can be expected from this kind of smelting operation.

The writer indicated the ultimate efficiency of the fuel in the blast furnace as compared with the same fuel in the cycle of steam electric procedure. Furthermore, as specifically stated by the writer, the figure of 3.085 lb. of carbon is based entirely upon the theoretical data, as no actual fuel consumption figures in blast-furnace P₂O₅ production are known to him.

The theoretical electric energy consumption shown in Table II of the above paper is that of the bare phosphorus and CO production stage without any return of heat to the stock in the furnace from combustion of the products. Therefore, a fairer comparison of the energy requirement items (that is, coke versus power) would be upon the minimum coke consumption versus known attainable power consumption figures. We believe the \$3.25 per ton price for coke of 90 per cent carbon is extremely low and available only in limited locations and conditions.

For the sake of comparison we submit a tabulation of relative costs of coke (as fuel) and electric power on the same comparative basis as that for the relative sulphuric acid and electric power costs shown in Table III of the article.

Coke			Electric Power		
Price per Ton	Cost per Lb.	Fuel Cost per Lb. P ₂ O ₅	Price per k.w.h. to Equal Cost of Coke		
			At 2.75 k.w.h. per Lb. P ₂ O ₅	At 2.50 k.w.h. per Lb. P ₂ O ₅	At 2.25 k.w.h. per Lb. P ₂ O ₅
\$3.00	\$0.00150	\$0.00514	\$0.00187	\$0.00205	\$0.00228
3.50	.00175	.00600	0.00218	0.00240	0.00267
4.00	.00200	.00685	0.00249	0.00274	0.00304
4.50	.00225	.00771	0.00280	0.00308	0.00343
5.00	.00250	.00857	0.00311	0.00343	0.00381
5.50	.00275	.00942	0.00342	0.00377	0.00419
6.00	.00300	.01028	0.00374	0.00411	0.00457
6.50	.00325	.01114	0.00405	0.00446	0.00495
7.00	.00350	.01200	0.00436	0.00480	0.00533
7.50	.00375	.01285	0.00467	0.00514	0.00571
8.00	.00400	.01370	0.00500	0.00548	0.00610

Basis: 3.085 lb. C per lb. P₂O₅ in Acid; or, at 90 per cent C., 3.427 lb. Coke

From this may be selected the comparative energy costs of the two respective processes, for prevailing conditions. This must be interpreted in the light of the

foregoing statements of method of derivation of the basic data, wherein sound theoretical considerations are taken in the absence of practical data from existing operations in the blast furnace case.

Third, Mr. Kochs calls attention to the remaining heat value after the smelting functions have been performed by the fuel. In the explanation above of the derivation of the carbon requirement factor, the heat recoverable for the smelting operation through preheating of the air from the oxidation products of the waste gases is accounted for as concerns the blast furnace. This appears to be the only means of applying any of the heat derivable from the oxidation products of the furnace to the smelting operation in the blast furnace. Inherent difficulties of preheating the blast-furnace charge, as such, through exothermic gas reactions will defeat the fundamental principles of blast-furnace operation, as is well known to all experienced in this highly developed metallurgical apparatus. The blast furnace requires considerable power for compression of air and auxiliary equipment, which will consume a large portion of the heat available from combustion of the P₂ and CO, in addition to that recoverable through heating of the blast. The inherent difficulties of heat exchange from such gases, due to the highly corrosive and erosive influence of P₂O₅, are subject to the same solution of the problem, regardless of whether their source be electric or fuel fired furnaces.

On the other hand, the electric furnace process requires substantially no power or heat other than that directly applied in the smelting operation. The highly concentrated form of the exit gases from such operation provides excellent conditions for their service in preheating the charge, whereby the recovery replaces electrical energy directly, rather than conversion to equivalent coal value of heat. Mr. Kochs interprets the writer's statement to the effect that "such recovery is not now an accomplished fact." This is true relative to the ultimate degree of such recovery we know to be available through means now under development. Therein he specifies the potentialities of vastly greater economies in the electric process.

BETHUNE G. KLUGH.

Vice-president, Federal Phosphorus Company, Birmingham, Ala.

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Ethyl Alcohol Distillation Improvements Questioned

To the Editor of Chem. & Met.:

Sir:—In an article entitled "Ethyl Alcohol Industry Improves Distillation Processes" (*Chem. & Met.*, December, 1929), the various distillation methods are illustrated and described, and the Chute process of slop recovery and the U.S. patent 963,275 are illustrated. Naturally, improvements have been made in it since the issue of the patent, but the description and the diagram of the process showing the travel of the liquors are well developed.

Unfortunately, an error has crept into the text by inserting the word "no," which naturally alters the meaning. The last sentence on page 718 should read: "In case slopping back is practiced a part of the slop coming from the beer still is used for the dilution of the succeeding molasses or grain mash, thereby increasing the percentage of solids in that portion of the slop to be evaporated and requiring less evaporation. Otherwise the evaporators will be burdened with the dilute slop not returned." The cut has a like error in stating: "the

capacity of the evaporators are decreased 5 per cent." The capacity of the evaporators remains the same, but slopping back reduced the amount of slop to be evaporated by the amount returned to the fermenters or mash.

Fig. 4 shows 8 gal. of steam for distilling 40 gal. of mash, and this is correct according to experience, but, as shown above, any further economies desired can be furnished to those who will pay the price. This is warranted under European conditions of expensive fuel and cheap labor, but not in the United States. We wish to thank the author for the full and accurate description of our process and suppose the errors were inadvertent.

In Fig. 1 are shown the two stills used in the United States. The writer has not seen the beer heating by escaping hot slop practiced in the United States, though it is illustrated in all European books. The two dephlegmators shown are not usual but a beer heater is universally used. The author well calls attention to the value of exhaust steam for all distillation purposes.

The author's proposal to use an evaporator in place of a column still for separating alcohol from the slop is one that will surprise those familiar with both kinds of apparatus. Each vessel of a multiple effect may be compared to each chamber of a rectifying still, but the still usually has 20 chambers while the effect has three, and only two can be used for separating alcohol. If two chambers are sufficient, then the stills are improperly constructed. The diagram shows 30,000 gal. of 25 per cent alcohol coming from the first effect, which would therefore contain 7,500 gal. of pure alcohol. The second effect gives off 30,000 gal. of 16 per cent alcohol, which would contain 4,800 gal. or perhaps it is 1.6 per cent, which would therefore have 480 gal. of pure alcohol. The two liquors therefore yield 7,980 gal., which is quite high if the beer contains 8,000 gal. pure alcohol. Those who are familiar with multiple effects will doubt that any such separation can thus be made.

About 1904 the present writer started work on the removal of methyl alcohol from pyroligneous acid from wood distillation and the distilling of the acid for acetic acid. The slop recovery system is one result, but it was found necessary to remove alcohol before evaporating in the multiple effect, as the alcohol vapors did not condense in the calendria, which became "air bound" with alcohol vapors, or, if cooled till the alcohol condensed, the succeeding pans were not hot enough to work. In the author's second effect under 12-in. vacuum, the alcohol would boil at 80 deg. C. under the 5 lb. pressure in the calendria; but water requires 86 deg. to boil under the 12-in. vacuum, so the evaporation stops. That the alcohol can be all removed in the first two vessels is against experience and it is feared that there is a large loss in the barometric condenser.

The above should show that nearly all the problems confronting the newer distillers were worked out by the old ones in pre-war and pre-prohibition days. When an industry has changed conditions it nearly always develops a new set of manufacturers.

H. O. CHUTE.

Consulting Chemical Engineer,
New York.

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Dr. Reich Responds

To the Editor of Chem. & Met.:

Sir:—I appreciate your giving me an opportunity to clarify some of the issues raised by Dr. Chute. "Slopping back" had been practiced prior to his patent and

described by Bradley and Dickerson in their U. S. patent No. 504,074 (1893). The reader being able to calculate that certain gallons of slop returned obviously will decrease correspondingly the volume to be evaporated, I therefore deemed it advisable to describe only his method of distillation without slopping back.

I am somewhat surprised that Dr. Chute sees great difficulties in the recovery of alcohol in a multiple effect evaporator. Misunderstanding obviously will result if the evaporator is expected to function as a fractionating still. The evaporation system is recommended to be used in conjunction with the utilization of the slop, and the vapors from the first effect are fractionated in order to raise the proof of alcohol to the desired strength. This shows that there is no indication of the omission of the still, and the main principle of this process is to eliminate the handling of a large volume of beer in the still.

As to his doubt of the percentage of alcohol recovered in the first effect, this is not 90 per cent but actually 93 to 96 per cent, and removal of the remaining alcohol is a matter of manipulation and construction of the evaporator. The test for alcoholic losses should be made on the liquor going to the last effect and not on the diluted condenser water.

Neutralization with an alkali metal salt instead of lime and other features are part of the recovery of the slop and not of the evaporation. Also, the liquor from the second effect is used for slopping back before and not after its concentration. His reference as to the boiling points needs some corrections, as, according to Dönnitz, a liquid containing 2 per cent of alcohol by volume yields a distillate containing 28 per cent of alcohol by volume, and the temperature of the vapor will be 98.2 deg. C.

A comparison between other processes cited and mine is not applicable, as a closer perusal will disclose their dissimilarity in operation and construction.

Pennsylvania Sugar Company,
Philadelphia, Pa.

GUSTAVE T. REICH.

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A Re-Formulation

To the Editor of Chem. & Met.:

Sir:—In an article by Joseph Kaye Wood appearing in the December, 1929, issue of *Chem. & Met.* under the title of "Calculation of Tanks for High Temperature and Pressure" there is given a formula for computing the weight of tanks. I was interested in this formula, which I had never seen before, and worked it out to determine its derivation. According to my results the third term should be $D/3$ rather than $3D$. The entire equation should therefore be

$$\text{Total Weight} = \pi t \left[D \left(l + \frac{D}{3} + \frac{4b}{3} \right) + t \left(l + \frac{4b}{3} \right) - \left(\frac{d_x^2}{4} + \frac{d_y^2}{4} + \dots + \frac{d_n^2}{4} \right) \right] \infty + \text{Weight of connections} \quad (4)$$

JOHN S. THORP.

Day Superintendent, Station B,
Montreal Light, Heat & Power Consolidated,
Montreal, Canada.

Note: Inquiry from Mr. Wood developed the fact that the formula as given above by Mr. Thorp is correct, the error having been introduced in the transcribing of the original manuscript.—Editor.

CHEMICAL ENGINEER'S BOOKSHELF



Tin Production and Uses

TIN: Its Mining, Production, Technology and Applications. By C. L. Mantell. The Chemical Catalog Company, New York, 1929. 366 pages. Price, \$7.

Reviewed by DUNCAN MACRAE

OBJECT of this series of monographs is "to present the knowledge available upon the chosen topic in a readable form, intelligible to those whose activities may be along a wholly different line," and "to promote research in the branch of science covered by the monograph by furnishing a well-digested survey of the progress already made in that field and by pointing out directions in which investigation needs to be extended." Dr. Mantell states in his preface that "the author has attempted to cover the subject of tin in a comprehensive manner," and "this volume is an attempt to gather together as much as possible of the authoritative available information for the use of those in the various fields in which tin finds application." These objects have been quite successfully attained and the result is a valuable contribution not only to this excellent series of monographs but also to the literature of tin. While there are other books on tin which treat a single aspect of the subject in greater detail, no other book on tin approaches this one in general comprehensiveness.

Interesting possible future developments in the metallurgy of tin are indicated in the chapter on "Gaseous Reduction, Leaching, and Metallic Reduction." The reviewer is not in entire agreement with Dr. Mantell as to the promise of gaseous reduction in this connection. The part which it will play in commercial developments remains to be seen.

For future editions, it is suggested that consideration be given to the inclusion of material on the atomic weight of the metal and the chemical equilibria involved in the reactions of its compounds and that the thermochemical data be treated with the same critical thoroughness as has been used in listing the physical properties of the metal.

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Steel in Severe Service

CREEP OF STEELS AT HIGH TEMPERATURES. By F. H. Norton. McGraw-Hill Book Company, New York, 1929. 90 pages. Price, \$3.

Reviewed by M. S. NORTHUP

THE WORK of F. H. Norton is a valuable contribution to our knowledge of the behavior of steels when subjected to tensile stresses at elevated temperatures.

Of particular interest to users of the Austenitic type of alloy tubing are the data on rates of creep with different stresses at temperatures ranging from 1,000 to 1,500 deg. F. Steels of this type exhibit creep values of from eight to ten times those of low-carbon steels. The manufacturers of high-pressure boilers and the oil industry, where high pressures and temperatures are used, will find the results of Norton's work particularly adaptable to design.

The Babcock & Wilcox creep-testing equipment de-

scribed, consisted of three units, each containing six samples in a single furnace. Measurements of extension by means of dial gages reading to 0.0001 in., and stressing of samples was done at the top of the furnaces.

The method of plotting stress for definite creep values on semi-logarithmic paper is unusual and very convenient, as a few points will allow the drawing of a representative curve from which can be read off the safe load for any extension rate or life.

The appendix containing results of tests at 900 deg. F. and of three carbon steels has augmented the results given in the book. Three distinct types of steels were investigated: (1) Austenitic steels; (2) stainless steels and irons; (3) steels of Pearlitic nature in the annealed condition. It is regrettable that the complete history of the Austenitic steels is unknown, because of the tremendous effect of mechanical work, finishing temperatures, and heat treatment.

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A Monolith of Silicate

SOLUBLE SILICATES IN INDUSTRY. By James G. Vail. The Chemical Catalog Company, New York, 1929. 443 pages. Price, \$9.50.

Reviewed by A. E. MARSHALL

THE DICTIONARY that I use has a definition of Monograph, "A separate treatise on a single object or class of objects," and a few paragraphs further, Monolith, "A single block of stone, especially one shaped into a pillar or monument." It is customary for book reviewers, when confronted by a six-volume work dealing, let us say, with the order of Coleoptera, to refer to "this monumental work," meaning, of course, that the work has distinct possibilities as a support for the drop-leaf of a sewing machine.

In his 443 pages, which include an authors' and an excellent subject index, J. G. Vail has made himself a monolith out of a monograph; and this reviewer, without regard to alliteration or the one-inch thickness of the book, is going to add that it is a monumental work in the thoroughness of its treatment of every scientific phase and technical application of the soluble silicates.

It is given to few of us to cultivate a restricted area within the fields of pure and applied chemistry, but after many readings of Vail's book, one has the wish that other areas could be as intensively cultivated and the results presented in form as compact and lucid as here. The reviewer is not surprised that *Chemistry & Industry* gave it editorial treatment, for we have too few books of its type and too many in which a little learning is spread from a paper covered pamphlet to something the book-sellers call "full calf gilt."

"Soluble Silicates" deals with a material produced at a rate of something over 500,000 tons a year in this country and perhaps 150,000 tons elsewhere. The uses for silicates of soda are of surprising extent, and no better view of the industrial distribution can be obtained than by realizing that Vail has packed six chapters full

of information and references on Cements; Adhesives and Adhesive Mixtures; Sizes and Coatings; Detergents; Gelatinous Films; and Miscellaneous Uses. The chapter on cements is particularly valuable to the chemical engineer, as it not only gives a tabular presentation of the acid resistance of silicate cements, as determined in his own laboratory, but also a complete reference list.

It is impossible to really "review" the book, because of its many facets. The careful preparation has also removed the chance of using review space to draw attention to errors and misprints, which at times has enabled reviewers of books to conscientiously apply for the acting part of Nero. It is as one of the "voices off stage" and not because of a Nero complex that a correction is suggested in the historical preface. On page 13 Vail says, "In 1867, W. Gossage & Sons, of Widnes, England, exhibited a soap said to contain 30 per cent of a 20-deg. Bé. solution of sodium silicate." William Gossage patented in 1857 his "mottled silicated soap" and in 1862 (not 1867) was awarded a medal at the International Exhibition for the "excellent quality" of this product. To the question of his particular interest in this fact, the reviewer would answer that as boy he used the odor of Gossage's Soap Works as a unidirectional windvane.

Everyone directly interested in soluble silicates should be aware of Vail's book by this time. To those who have only a casual acquaintance with silicate of soda, it can be recommended as an accomplishment in technical writing, and one which is more than likely to repay its reading by presenting some unsuspected use which may aid in the solving of a problem.

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Coal-Products Testing

SAMPLING AND ANALYSIS OF COAL, COKE AND BYPRODUCTS. Published and sold by Carnegie Steel Company, Pittsburgh, 1929. 334 pages. Price, \$3.

Reviewed by R. S. McBride

IN THIS revised (third) edition, the standard work of the Steel Corporation staff is again worthy of the prominent position accorded earlier numbers of the series. Because of the inherent empirical form and significance of many coal and coal-products tests, it is extremely important that there be a large measure of standardization of procedure. Within the steel industry the largest influence toward such uniform practice has been accorded by this particular volume in its earlier editions. The new number doubtless will have a similar important influence. It is to be regretted that there has not come to be absolute uniformity of practice in matters of proximate analyses of coal and of the other empiric test procedures. If it were feasible to have the A.S.T.M., American Chemical Society, American Gas Association, and Steel Corporation methods identical throughout, this would be ideal. But despite the lack of perfect uniformity there is sufficient similarity in result so that for most practical purposes the differences are still negligible. The fact that there are differences means not only that there remains considerable work to be done by the chemists of the industries involved, but also that somewhat different purposes are being served by somewhat different procedures and that those in one group often find a more useful value by the modified procedures which they follow.

Inorganic Separations

SOLUTIONS OF ELECTROLYTES. By L. P. Hammett. McGraw-Hill Book Company, New York, 1929. 211 pages. Price, \$2.25.

Reviewed by JOHN E. VANCE

ITS TITLE is slightly misleading since this book's purpose is not to discuss the theoretical aspects of solutions but simply to illustrate and explain the common phenomena found in qualitative separations. This is done very thoroughly and the basis for the operations in qualitative analysis is well known. Accompanying the text are numerous experiments which exemplify various separations. Lecture experiments with the same object in view also are included.

It should be emphasized that there is no attempt to present a systematic procedure in qualitative analysis, since it is the author's opinion that most of the advantage in studying qualitative analysis is lost by adhering to a strict routine. However, if the subject is to be used later, it seems that it must, by its nature, be largely routine. Consequently the book could not very well form the foundation for a qualitative course, although it could very nicely precede it, possibly taking a position in elementary inorganic training.

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Recently Arrived

ENDUITS CELLULOSIQUES. By W. Main. Gauthiers-Villars et Cie., Paris, 1930. 216 pages; 5½x9 in. Price, 25 fr.

Lacquers and cellulose-base coatings in general have necessarily had more vigorous development here, where their widest applications exist, than in France. This situation is conspicuous in the present book, which not only refers constantly to American developments but must even seek some of its nomenclature here. Nevertheless, and in spite of some muddled notions on synthetic resins as plasticizers, it represents a desirable compilatory effort with its tabulations of solvents, diluents, pigments, compositions, and the like. This does not make it more probable, however, that American technologists will be compelled, by need, to digest it.

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TEXTBOOK OF INORGANIC CHEMISTRY. Vol. VI, Part 3: Vanadium, Tantalum, Niobium. By Sydney Marks; edited by J. Newton Friend. J. B. Lippincott & Company, Philadelphia. 222 pages; 6x9 in. Price, \$10.

Apparently a general appreciation of the fact that a Friend's words are precious has supported this expensive but altogether deserving series. This newest accretion will perhaps command some especial attention because of its subject matter, vanadiums, tantalum, and niobium (columbium, in the U.S.A.). As always, the treatment is very thorough, but in view of the commercial efforts expended of late years on these metals, it will be the more widely welcomed for being a standard chemical source book.

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INTERNATIONAL ACETYLENE ASSOCIATION. Proceedings, Twenty-ninth Convention. Published by the Association. 289 pages—Annual convention report, including technical papers and committee reports of the sessions held in Chicago in November, 1928.

CHEMIST'S POCKET MANUAL. Fourth edition. By Richard K. Meade. Chemical Publishing Company, Easton, Pa., 1929. 533 pages. Price \$5.—Revised in the light of new data accrued in the past ten years; though the emphasis is on chemical rather than engineering usefulness, yet a number of industrial fields also are covered.

Selections from Recent Literature

DEBENZOLIZING GAS. W. Kärsten. *Teer und Bitumen*, Jan. 1, 1930; pp. 1-3. The scrubbing process of recovering benzol and naphthalene from illuminating or coke oven gas leaves 4 to 6 g. of benzol per cubic meter in the gas, and small amounts also in the scrubbing oil. The adsorption (silica gel) process described requires expensive plant and close supervision, and the gas must first be thoroughly freed from tar and hydrogen sulphide. Both methods require a distillation operation after removal of the benzol from the gas. A method utilizing compression and refrigeration has therefore been developed for direct recovery of both benzol and naphthalene, in one operation. In this process effective separation does not depend on the temperature of the gas or its cooling water, so that the process is especially suitable where the available cooling water is warm or small in quantity and the gas to be treated therefore has a relatively high temperature. The quantity of benzol left in the gas is not over 1 g. per cubic meter; and, unlike the scrubbing method, the efficiency of separation is as high in summer as in winter. In the scrubbing process artificial heating of the circulating oil may be necessary in winter; in the new process winter temperatures merely facilitate the refrigeration. There is the further advantage that benzol, toluol, naphthalene and naphthalene oil are all removed from the gas in one operation.

REFRACTORIES FOR GAS MAKING. J. G. de Voogd. *Het Gas*, January, 1930; pp. 15-22. Materials for refractories to be used in gas manufacture are limited mainly to silica and chamotte, the physical and chemical requirements of which are discussed. Tests are described for specific gravity, porosity, optical properties, melting point, and composition. Porosity of refractory brick made in Holland is seldom less than 20 per cent; in Germany, 28 per cent is considered high; but in England higher porosities are found, even as high as 39 per cent; different preferences exist as to composition of silica brick. The Seger cone number, formerly much used as a test, has lost much of its favor because the true criterion of performance is the temperature at which the refractory weakens too much to sustain its load, not at which it melts.

BATCH AND CONTINUOUS KILNS. Marceau Gabillon. *Ceramique*, January, 1930; pp. 1-6. Advantages of continuous operation have tempted many designers and users of furnaces and kilns to adapt continuous kilns to uses for which they are not suited. Others, still using batch kilns, do not fully appreciate the advantages which

can be derived from their proper design and use. This is particularly true of kilns of the alandier type, which are excellent for securing maximum combustion efficiency. It is generally believed that the number of alandiers should be as large as possible; but in reality it is better to use as small a number as practicable, and devote more attention to uniform distribution of combustion gases. Without considering any of the accidental sources of heat loss, the alandier system permits several ways of saving heat. These include about 10 per cent by improved combustion control; 5 per cent in decreased radiation from outside walls; 10 per cent in smaller permissible kiln size; 5 per cent by improved distribution of combustion gases; 10 per cent in shorter time per heat, corresponding to enlarged capacity; and 10 per cent by utilizing fuel remaining in the alandiers at the end of a heat. Thus an aggregate saving of about half the ordinary fuel cost for kiln firing is possible. Practical considerations in the proper use of the alandier system are discussed.

DROP VISCOMETER. H. L. Matthijssen. *Chemisch Weekblad*, Jan. 11, 1930; pp. 20-3. Since Engler viscometers are not suitable for very viscous liquids at 20 deg. C., namely at room temperature, where such information is needed are linseed oil, stand oil, coal tar, waterproof varnish, and the like, and since the viscosity of these liquids at 50 deg. C. does not give a reliable criterion of their behavior at 20 deg. C., Fischer's drop viscometer is recommended for these conditions. The apparatus is simple and easily operated, and a measurement, including bringing the liquid to 20 deg. C., can be completed in a short time. Duplicate tests can be readily and quickly made. The apparatus is breakable, but not more so than many other instruments; glycerol is recommended as the calibrating liquid. Balls giving four different drop times were used in one calibration: Iron, small, 1.9 sec.; iron, large, 3.3 sec.; aluminum, small, 6.8 sec.; aluminum, large, 10 sec. An equation is given for converting the observed viscosities to absolute viscosity, and numerical data are recorded for a special tar, a waterproof varnish and a zinc white paint in stand oil.

CENTRIFUGAL SEPARATIONS. Venzke. *Brennstoff-Chemie*, Jan. 15, 1930; pp. 27-8. Centrifugal drying of granular materials (down to 0.1 mm. particle size) has the advantage of giving the greatest drying effect, without use of heat. Centrifuges with perforated baskets are used, a metal screen being applied to retain the smallest particles.

Where particles less than 0.1 mm. in size are present, a cloth filter may also be needed. If there are too many fine particles, flow of liquid is hampered and the drying is ineffective. This is why a centrifuged flotation sludge still retains about 26 per cent of moisture. A centrifuge has been developed for continuous drying of coking coal. It is used both for drying the coal as it comes from the washer, and for removing clay and dirt along with the water. Another centrifugal machine has been developed for separating heavy from light oils, and solid from liquid in oil sludges. Both machines are described and illustrated. The coal drier is made in capacities up to 25 tons per hour, with power consumption amounting to about 1.3 hp. per ton. The drying efficiency depends on the kind and particle size of the coal. As a specific instance, a Bochum coal, particle size 0.3 to 6 mm., water content 20 per cent, was dried to a water content of 8 per cent.

FILTRATION STUDIES. Gino Bozza and Ismaele Secchi. *Giornale di Chimica Industriale*, October and November, 1929; pp. 443-8, 487-92. Some of the laws of filtration have been tested by experiments with quartz and galena filters having different particle characteristics. The liquids used for trial included water, aqueous calcium chloride, alcohol, benzene, petroleum oils, etc. It was observed that Darcy's law was strictly obeyed except in certain filter beds of very fine but not evenly graded galena, under high pressure gradients. The observed filtration constants agree with Slichter's empirical constants in the case of homogeneous, well washed quartz filter beds. They do not agree with constants calculated according to the Emersleben theory, nor according to a simplified hypothesis which compares the filter with a system of capillary tubes. For a given filter bed, a liquid with high surface tension passes more easily than one with low surface tension; thus, water and aqueous solutions have filtration constants about 1.3 volts greater than alcohol, benzene and oils on a quartz filter bed. On galena filter beds the difference is still more, ranging from 1.5 to 1.8 volts. This illustrates the mutual influence of the solid and liquid in a filtration system, an influence which is probably due to the interfacial tension between solid and liquid. Curves and tables are given to summarize the numerical data, and drawings of the apparatus involved in this discussion are offered by way of clarification.

THERMAL INSULATION. Harvey B. Lindsay. *Refrigerating Engineering*, January, 1930; pp. 9-11. Insulants are in use, for low temperature insulation, in which the K values range from 0.23 to 0.37, a variation of 60 per cent. The lower values of some insulants are not always compensated by superiority in other properties; hence to specify insulation by thickness, as is

often done, has no significance whatever. From theoretical reasoning it seems probable that the chief factors in resistance to heat transfer are surface regularity and surface rigidity of the walls of the air cells of the insulant. Regularity does not depend on temperature, but rigidity may be greatly increased by cold.

ELECTROLYTIC HYPOCHLORITE PLANT. *Apparatabau*, Dec. 27, 1929; pp. 301-3. The general considerations to be followed in efficient application of the electrolytic method of producing bleaching liquor (hypochlorite) are stated, on the basis of various types of apparatus which have been designed for the purpose. Increasing the concentration of the salt solution, by increasing conductivity, lowers capital costs, improves electrolytic efficiency of the

current consumed and lowers power consumption; but it increases salt consumption. Increasing the decomposition potential, and hence the current density, decreases capital costs and salt consumption, but increases power consumption. More rapid circulation of the solution in the apparatus decreases the electrolytic power consumption and the salt consumption, but requires some capital expenditure for better pumps and consumes some power in greater liquid circulation. Higher temperature lowers capital costs, but favors chlorate formation and so decreases the electrolytic efficiency. Imhoff found that decomposition of the water, resulting in reduction of part of the hypochlorite, could be lessened by adding amphoteric oxides such as alumina, silica, boron trioxide, etc. Small amounts of soluble chromates have a similar effect.



Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Thermal Properties of Petroleum Products. Bureau of Standards Miscellaneous Publication 97. 15 cents.

Weights per United States Gallon and Weights per Cubic Foot of Sugar Solutions. Bureau of Standards Circular 375. 5 cents.

Bauxite—Float-and-Sink Fractionations and Flotation Experiments, by B. W. Gandrud and Fred D. DeVaney. Bureau of Mines Bulletin 312. 25 cents.

Analyses of Kansas Coals, by Raymond C. Moore. Bureau of Mines Technical Paper 455. 10 cents.

Classification and Tabling of Difficult Ores, With Particular Attention to Fluorspar, by W. H. Coghill. Bureau of Mines Technical Paper 456. 15 cents.

Centrifugal Concentration, Its Theory, Mechanical Development, and Experimental Results, by H. A. Doerner. Bureau of Mines Technical Paper 457. 10 cents.

Effect of Manganese on Distribution of Carbon in Steel, by B. M. Larsen. Bureau of Mines Technical Paper 466. 20 cents.

Re-forming Natural Gas in Water-Gas Generators, With Substantially Complete Elimination of Entrained Carbon, by W. W. Odell. Bureau of Mines Report of Investigations 2973. Mimeographed.

Mica—Part I. General Information, by W. M. Myers. Bureau of Mines Information Circular 6205. Mimeographed.

Present-Day Knowledge of the Chemical Constitution of Coal, by J. B. Shohan. Bureau of Mines Information Circular 6212. Mimeographed.

Dynamites: Their Propulsive Strength, Rate of Detonation, and Poisonous Gases Evolved, by N. A. Tolch and G. St. J. Perrott. Bureau of Mines Report of Investigations 2975. Mimeographed.

Odor Intensity and Symptoms Produced by Commercial Propane, Butane, Pentane, Hexane, and Heptane Vapor, by F. A. Patty and W. P. Yant. Bureau of Mines Report of Investigations 2979. Mimeographed.

Flow of Gas in the Blast-Furnace Shaft, by S. P. Kinney. Bureau of Mines Report of Investigations 2978. Mimeographed.

Reaction of Metallic Iron and Copper Sulphate in the Flotation of Sphalerite, by Fred D. DeVaney and C. W. Ambler, Jr. Bureau of Mines Report of Investigations 2970. Mimeographed.

Leaching Silver in Unroasted Tailings With Ferric Salts in Saturated Brine, by G. L. Oldright. Bureau of Mines Report of Investigations 2981. Mimeographed.

Government Publications Lists, as follows: List of Available Publications of the U. S. Department of Agriculture, June 1, 1929, issued as Miscellaneous Publication 60. 10 cents; Subject Index of U. S. Tariff Commission Publications, Revised, October, 1929. 10 cents; List of Publications of Bureau of Mines, 1910-1929, with an Index by Subjects and Authors; and Publications of the Bureau of Foreign and Domestic Commerce, revised to November, 1929.

Mineral Resources of the United States, 1926, Part I. Metals. Compiled by F. J. Katz. Bureau of Mines document. \$1.25.

Investigations in Weed Control by Zinc Sulphate and Other Chemicals at the Savenac Forest Nursery, by W. G. Wahlenberg. U. S. Department of Agriculture Technical Bulletin 156. 15 cents.

Summarized Data of Lead Production, by Lewis A. Smith. Bureau of Mines Economic Paper 5. 15 cents.

Mineral production statistics for 1928—Separate pamphlets from Bureau of Mines on: Antimony, by Paul M. Tyler, 5 cents; Asbestos, by Oliver Bowles and B. H. Stoddard, 5 cents; Chromite, by Lewis A. Smith, 5 cents; Feldspar, by Oliver Bowles and Jefferson Middleton, 5 cents; Graphite, by Jefferson Middleton, 5 cents; Iron Ore, Pig Iron, and Steel, by Hubert W. Davis, 10 cents; Magnesium and Its Compounds, by Paul M. Tyler, 5 cents; Potash, by A. T. Coons, 5 cents; Salt, Bromine, and Calcium Chloride, by A. T. Coons, 5 cents; and Secondary Metals, by J. P. Dunlop, 5 cents.

Mineral production statistics for 1929—preliminary mimeographed statements from Bureau of Mines on: lead and zinc; slate; copper, lead, and zinc; copper; iron ore; manganese; and lime.

Production statistics from 1927 Census of Manufacturers—printed pamphlets on: The Gas and Coke Industries; the Rubber Industries; Paints and Varnishes, Bone Black, Carbon Black, and Lamp Black; Power Laundries and Dyeing and Cleaning Establishments; Ammunition, Explosives, Firearms, and Fireworks; Miscellaneous Food Products; Electrical Machinery, Apparatus, and Supplies; and Tin and Other Foils, Not Including Gold and Silver Collapsible Tubes, Gold and Silver, Leaf and Foil.

National Survey of Fuel Oil Distribution, 1928, by E. B. Swanson. A Bureau of Mines report printed by the American Petroleum Institute.

Paper and Paper Board: Production, and Paper-Making Equipment in Use, Pulpwood Consumption and Wood-Pulp Production, 1928. Compiled by the Forest Service and issued as a pamphlet of the Bureau of the Census. 5 cents.

Statistical Abstract of the United States, 1929. Bureau of Foreign and Domestic Commerce, bound volume. \$1.

Tariff Documents, as follows: Comparison of Rates of Duty in the Pending Tariff Bill of 1929 With the Tariff Act of 1913 and the Tariff Act of 1922, compiled by U. S. Tariff Commission, issued as Senate Document 30, 71st Congress, 1st Session, 50 cents; Tariff Preference in Great Britain and British Possessions, compiled by Library of Congress, issued as Senate Document 31, 71st Congress, 1st Session; Ad Valorem Tariff Rates in Certain European Countries and the United States, Including England, France, and Germany, compiled by U. S. Tariff Commission, issued as Senate Document 32, 71st Congress, 1st Session; and Tariff Increases in Various Countries, 1922 to 1928, Inclusive, compiled by Library of Congress, issued as Senate Document 33, 71st Congress.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN



Decreasing Flammability of Wood and Fabrics

CONSIDERABLE EFFORT has been put forth by the U. S. Bureau of Standards in the investigation and development of fire-retardant treatments for wood and other cellulose materials. While the results which the Bureau reports are not considered by any means the last word in this important safety field, they are valuable as showing the present state of the art.

WOOD

Several processes have been in use, involving the injection of chemicals into wood, to make it more or less fire-retardant. For interior work, ammonium phosphate and ammonium sulphate and combinations of them have been much used for this purpose. Other chemicals that have been used or proposed are ammonium chloride, sodium borate, and zinc chloride. Most of these chemicals are soluble and would be washed out where exposed to the weather, and possibly when used in floors if the floors are cleaned by washing.

For outside use a combined treatment with sodium borate and zinc chloride has been proposed and in laboratory tests found fairly efficient. The resulting salt, a zinc borate, is less soluble than the other salts mentioned. If a sufficient amount of the above chemicals is injected it will make the wood fire-retardant in the sense that it will not flame at ordinary temperatures, although at higher temperatures it will char and the volatiles will distill off and burn.

Fire-retardant surface treatments for wood generally have only minor value in preventing ignition from contact with small flames, due to the thinness of the film and its rapid destruction in contact with flame. Practically all well-maintained paint coatings have some fire-retardant value in this respect, but none can be considered as affording any considerable protection. From a series of tests with different kinds of standard and retardant paints conducted at the Bureau some years ago it was concluded that as much or more fire-retardant effect can be obtained with whitewash and sodium silicate as with any proprietary paint, as it concerns inside use.

Sodium silicate solution is made by diluting one volume of commercial water glass solution, 1.39 specific gravity, with two volumes of water. The whitewash solution is made by mixing ten parts slaked or hydrated lime, and one part portland cement with salt water to produce a thin solution.

Another formula for whitewash known as the "Government" or "Lighthouse"

Dollars for Ideas

HAVE YOU an operating idea? Do you know of an original plant kink? Or more than one? Plant Notebook enters its sixth year seeking new faces among its contributors. Fancy writing is not at all necessary: the back of an envelope will serve if no other paper is handy. If you have photographs or can make a rough but intelligible sketch, so much the better.

THIS is your opportunity to give other engineers the benefit of those effective shortcuts and kinks that have evolved in your plant. And there is "smokes" money in it too, for Chem. & Met. pays \$5 or more, depending on length, for every acceptable contribution.

formula states: Slake $\frac{1}{2}$ bushel of unslaked lime with boiling water, keeping it covered during the process; strain it and add a peck of salt dissolved in warm water. Put 3 lb. of ground rice, in boiling water and boil to a thin paste. Mix $\frac{1}{2}$ lb. of powdered Spanish whiting and 1 lb. of clear glue dissolved in hot water. Mix these well together and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and when used put it on as hot as possible with painter's or whitewash brushes.

FABRICS

The following flameproofing method, generally known as the "non-flame" process, gives good fire-retardant effect with fabrics and has the further merit that the effect remains after the material has been subjected to washing or the weather. In tests made by the British Fire Prevention Committee*, flannelettes were found to have been little changed in this respect after 20 washings. The process consists in steeping the cloth in a solution of 3 lb. of sodium stannate per gallon of water (specific gravity 1.21). After wringing and drying it is passed through a solution of $1\frac{1}{2}$ lb. of ammonium sulphate per gallon of water used (specific gravity 1.07). After wringing and drying it is rinsed several times or in running water and finally dried.

This process may affect the luster, as of velvet, and it may induce slight color change in some fabrics. Whether this will occur with this as with other methods of flameproofing can best be determined in a preliminary trial with a small sample.

The chemicals used or produced in the following treatments are more or less soluble and hence should be repeated after the material has been washed one or more times or after exposure to the weather:

- 2 lb. ammonium sulphate
- 4 lb. ammonium chloride
- 3 gal. of water

Sodium silicate is fairly effective for interior decorations where change of color or luster is not important. For the purpose, one volume of commercial water glass (1.39 specific gravity) is diluted with one to five volumes of water, depending on the kind of fabric and the degree of fire-retardant effect desired.

Alum solutions in water are somewhat less effective, although they do not affect the color as much as sodium silicate. A concentration of 1 lb. per gallon of water is the highest concentration practicable for the purpose. Both treatments generally make the fabric stiff and glossy.

A formula that was developed by Chemistry Division of the Bureau for airplane fabrics is:

- 4 lb. sodium tungstate
- 1 lb. di-ammonium phosphate
- 2 gal. of water

The following formula has been recommended for flameproofing theatre scenery as not inducing change of color:

- $1\frac{1}{2}$ lb. boric acid
- $1\frac{1}{2}$ lb. crystallized borax
- 3 gal. water

Another formula, the chemicals in which are somewhat less expensive, but which may possibly affect color is:

- 3 lb. ammonium chloride
- 3 lb. borax
- 1 pint vinegar
- 3 gal. water

The following formula gives good fire-retardant effect but color and luster may be affected:

- 1 lb. di-ammonium phosphate
- 2 lb. ammonium chloride
- $1\frac{1}{2}$ gal. water

A method developed by the Chemistry Division for flameproofing awnings consists of coating the material first with a solution of 2 lb. of di-ammonium phosphate per gallon of water used, and then with a solution of $1\frac{1}{2}$ lb. of alum per gallon of water used. The precipitated aluminum phosphate is not as easily washed out as the common flame-retardant solutions.

*References on flameproofing of textiles and paper:

British Fire Prevention Committee Red Books Nos. 128, 148, 159, 162, 167, 245, the last number being by the National Fire Brigades Association, successor of the British Fire Prevention Committee.

Journal, National Fire Protection Association, Vol. 6, No. 2, page 179; Vol. 16, No. 2, October, 1922, and Vol. 16, No. 3, January, 1923. The articles in the last two references are by Kling and Florentin on the flameproofing of theatre scenery.

EQUIPMENT NEWS

from MAKER and USER

Traveling-Leaf Filter

A DISTINCTLY new principle in filter design is embodied in the Southwestern-Butler vacuum filter, made by the Southwestern Engineering Corporation, 606 South Hill Street, Los Angeles, Calif. This filter was originally developed for use in the metallurgical field but has since been found to have application on many other products.

The filter is best explained in conjunction with the photograph reproduced below. It will be seen to consist of a traveling belt-like device on which are mounted filter pockets, each one containing a filter leaf. The main element of the filter consists of a vacuum chamber casting, on the upper side of which is attached the stationary element of the vacuum connection. This consists of a sheet of flexible rubber which functions as an elongated "vacuum-cup." Along the center of this sheet is a slot through which the filter leaves are placed under vacuum and through which the filtrate is discharged.

At either end of the vacuum chamber are the head and tail shafts, fitted with sprockets over which the carrying chains of the filter run. These carry the filter leaves and frames and a rubber band which acts as the moving element of the vacuum connection. The leaves are of perforated metal covered with cloth and are said to be easily and quickly replaceable while the filter is in motion. They are about one-half the height of the compartment. On the top of every fourth or fifth leaf is a baffle plate, extending from one side of the compartment to the other, serving as a dam to confine the pulp to that section and allow it to distribute itself freely over the leaves in the section. In a recent improvement, overflow lips and a

trough have been added to control pulp level, as shown at the right of the photograph.

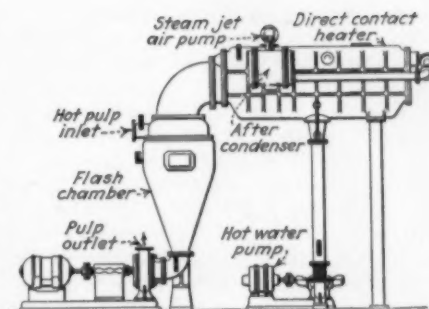
The drive mechanism consists of a large wheel fastened to the head shaft, driven intermittently by means of a variable-throw friction arm. The amount of movement of the mechanism is instantly adjustable by means of a hand wheel, with which it is possible to vary the speed of the filter from $\frac{1}{4}$ in. to 15 in. per minute.

Cake discharge is facilitated by means of a connection for air which is made to each filter leaf at the point of discharge. A valveless cylinder and piston causes the air to pulsate against the cloth and thus gives it a rapid shaking, said to assist materially in keeping the clothes clean.

In operation the filter may be fed directly from a pipe or open launder. It is pointed out that no agitation of the pulp is required, since its natural settling facilitates rather than retards filtering. Washing of the cake is possible before the discharge and is said to be very thorough. Other advantages claimed for the filter include the elimination of short-circuiting, instant speed regulation, small space requirement, and disproportionately large capacity.

Flash Type Exchanger

IN THE MAJORITY of cases heat exchangers of the conventional shell and tube type can be used. This simple method, however, is not possible when there are solids in suspension which would quickly plug ordinary apparatus. For this latter type of service, the Foster Wheeler Corporation, 165 Broadway, New York, has developed a new flash type exchanger consisting of the neces-



Single-Stage Flash Type Heat Exchanger

sary liquid circulating equipment, a flash evaporator and a direct contact heater.

One form of this exchanger is illustrated in the accompanying drawing. Hot pulp is admitted to the flash chamber at the left where it is automatically spread out to permit evaporation. Raw water feed enters the system through the after condenser of a steam-jet vacuum pump used to maintain vacuum on the system. It then passes into the heater through a spray where it comes in contact with, and absorbs the latent heat from, the steam which flashes off from the pulp feed. Hot water (raw water plus condensate) is then withdrawn by means of a pump at the bottom of the heater. The pulp, having been concentrated and cooled to a temperature corresponding to the degree of vacuum, flows into the suction of the pulp pump and thence from the system.

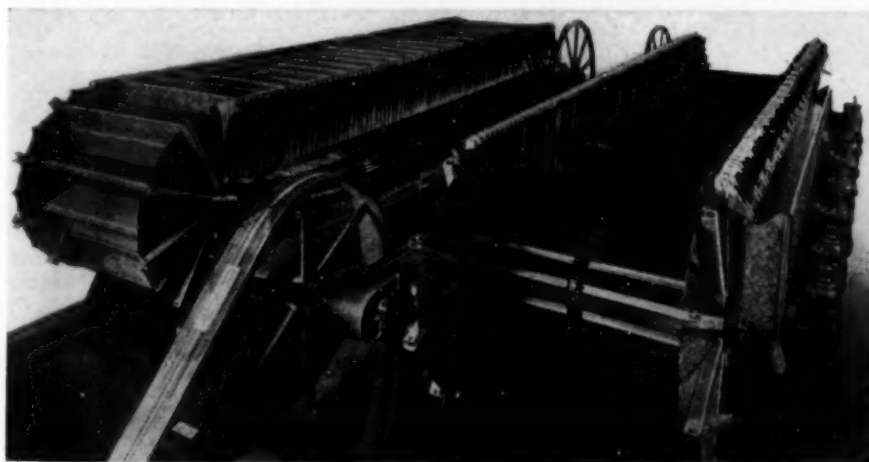
Greater heat savings are said to be effected by using this type of heat exchanger in two or more stages.

This system has already been applied in a paper mill and is reported to have been used successfully for a number of months. Using a two-stage evaporator it was found that the steam saving for the entire mill, resulting from the use of the exchanger, amounted to 42 per cent. It is believed by the manufacturer that this type of exchanger has many other applications in addition to the one already in use.

Pipe Benders

NEW AND IMPROVED bending equipment for tubing and pipe is announced by the American Pipe Bending Machine Company, 37 Pearl Street, Boston, Mass. The tubing machine handles steel, brass and copper tubing up to 1 $\frac{1}{4}$ in. O. D. Bending is done by hand power. The new type pipe bender handles standard gage pipe of various metals from $\frac{3}{4}$ to 2 in. in diameter. These machines are said to be capable of producing a large variety of bends.

Pair of Traveling-Leaf Filters, One Assembled and One Stripped, Showing Construction



Speed Reducers

TWO BRITISH developments in power transmission equipment have recently been introduced into the United States by the Universal Gear Corporation, 327 South La Salle Street, Chicago, Ill. The first is a fixed-ratio speed reducer known as the "Heliocentric," and the second, the "Revocentric," an infinitely variable speed reducer. The former, which has been in use in England since 1923, is shown in cross-section in Fig. 1. It will be seen to consist of a casing, around the inner periphery of which is an internal gear rack. Inside of this is a spool piece carrying a number of plungers which bear at their inner ends upon an eccentric. The eccentric is driven at the high speed of the motor and the construction of the apparatus is such that the spool piece, connected to the low-speed side, is driven at a reduced speed as the plungers are forced against the rack by the eccentric rotation.

For the sake of illustration, it is to be noted that the reducer illustrated has 25 plungers and 49 rack teeth. The angular distance through which the spool piece advances while the eccentric is turning through any given angle may be easily calculated. In the case illustrated it consists in the difference between the angular distance from one tooth to the second following, n , minus the angular distance between plungers,

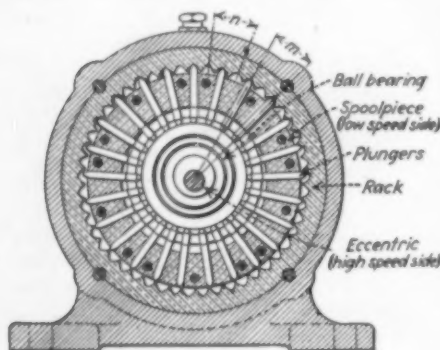


Fig. 1—Cross-Section of "Heliocentric" Speed Reducer

m . The ratio of the reducer is therefore $\frac{n-m}{n}$, or in this case 50 to 1.

Reducers of this type are made for reductions of from 8 to 1 up to 60 to 1 and, by using two or more reducers in series, in ratios as high as one million to 1. Sizes to transmit up to 50 hp. are available. These reducers also are built as an integral part of an electric motor.

The "Revocentric" reducer consists of an adjustable-throw eccentric on the input shaft, driving five clutches through toggle joints which are mounted between two disks on the output shaft. A section through the part of the reducer comprising the eccentric, the clutches, and the toggle joints is shown in Fig. 2.

Although it is not shown, the means for varying the throw of the eccentric is comparatively simple. By a hand-

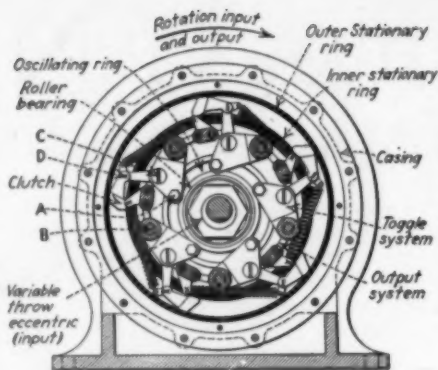


Fig. 2—Cross-Section of Clutch Mechanism of "Revocentric" Variable Speed Drive. The letters refer to pivot points in clutch-operating mechanism. See text

wheel or other method, the inner member of the hollow drive shaft is twisted with respect to the outer member by means of prongs which are keyed to the inner shaft and slide in helical slots in the outer. This causes the inner and outer eccentric members of the cam to turn with respect to each other and vary the eccentricity from zero to a maximum.

Referring to the drawing, the eccentric rotates at the input speed. It carries, on a roller bearing, a ring which is practically stationary angularly with respect to the output system, but which oscillates as the eccentric rotates. This ring carries a toggle system pivoted to the ring at point *A*. The toggle is also pivoted to the output system at point *B*. The output system remains concentric with the casing. Hence as the oscillating ring is forced outward at point *A* by the rotation of the eccentric, the toggle plate pivots about *B* carrying the arm *CD* outward. This causes the clutch to pivot at *D* and jam between the inner and outer stationary rings. As the point *A* continues to be forced outward after the clutch has jammed, the point *C* is forced farther from the line *AD*, carrying the point *B*, and hence the entire output system, forward in a clockwise direction.

This reducer is infinitely variable in output speed from one-thirteenth of the input speed to zero. The speed may be varied while the gear is in motion and under load. It is available in sizes up to 15 hp.

Dormant Scale

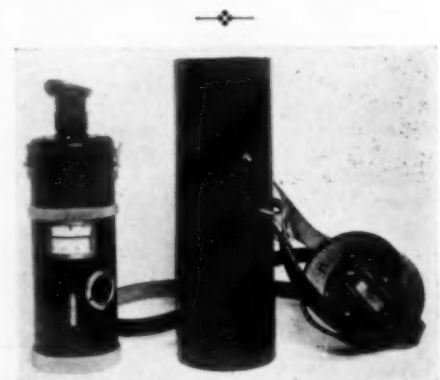
A DORMANT SCALE, said to be of a simple and reliable design, has been developed by the Standard Computing Scale Company, Detroit, Mich. Scale readings are indicated by a pointer on a dial by graduations of 1 lb. from 0 to 1,000 lb. A simple range-changing device makes it possible to increase the capacity to 2,000 or 3,000 lb. A locking device holds the platform when weighings are not being made, so as to preserve the sensitivity of the bearing surfaces. This scale is supplied with platforms in sizes from 36x48 to 48x72 in.

Electrical Equipment

NEW EQUIPMENT announced by the General Electric Company, Schenectady, N. Y., includes a 6-cylinder gas-engine-driven arc welder, a single-phase capacitor motor, and a new form of corrosion-resisting fiber duct for underfloor wiring. The welder is portable and is driven by a 6-cylinder gas engine, replacing the 4-cylinder engine previously included in this company's line. The motor develops 39 hp. at 1,440 r.p.m. Gasoline consumption averages 2.5 gal. per hour for average welding duty at full normal-rated load. The welding generator is equipped with anti-friction bearings and is rated at 300 amp. For outside work a protecting canopy is available. The weight of the welder is 3,300 lb., of the running gear 180 lb., and of the canopy 140 lb.

The new line of motors is of the single-phase, squirrel-cage, capacitor type, designated type KC. The motors are specially designed for quiet operation and are expected to find their principal application in the driving of blowers and low-torque centrifugal pumps. The motor is similar to a two phase machine in that it is self-starting. It is available in sizes from 1 to 25 hp. and speeds from 3,600 to 900 r.p.m.

The new duct is known as "G-E Fiberduct." It is intended for housing wiring under concrete floors. The material used is an impregnated fiber which is said successfully to resist corrosion. The wall thickness is $\frac{1}{8}$ in. and the cross-sectional dimensions are approximately 3 $\frac{1}{2}$ in. by 1 $\frac{1}{2}$ in. inside. The cross-section is substantially oval. Rust-resisting cast-iron junction boxes for use with the ducts are also available.



New Self-Contained Optical Pyrometer

Optical Pyrometer

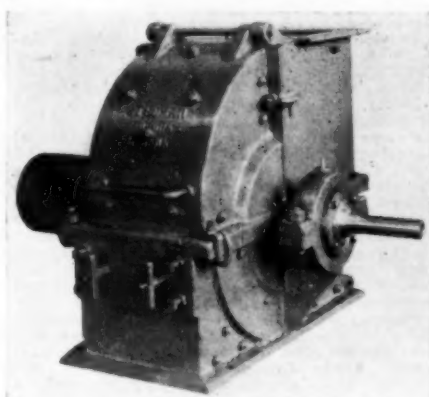
OPTICAL pyrometers operate by measuring some portion of the visible radiation of incandescent objects. This is ordinarily accomplished by comparing the intensity of a heated filament with the incandescent object. In the new Pyro Optical Pyrometer made by the Pyrometer Instrument Company, 50 Howard Street, New York City, comparison is made with the filament of a small electric lamp placed between a wedge of smoked glass and the eye. Assuming that the brightness of the

lamp filament is correct, the smoked glass wedge may be rotated until the apparent intensity of the radiating source is equal to that of the lamp filament, whereupon the filament disappears.

The new instrument is entirely self-contained, including a range-changing filter, a small battery, an ammeter and a rheostat for adjusting the lamp current. A standard lamp also is supplied whereby the correct ammeter reading may be determined for standard brightness of the lamp filament at any time.

New Hammer Mills

SWING- and ring-hammer mills in 25 sizes, from 5 to 250 hp., are announced by Stedman's Foundry & Machine Works, Aurora, Ind. This



Type A General-Purpose Hammer Mill

company is now offering hammer mills for the first time. The Type A general-purpose machine is built in seven sizes, using two-stage reduction. Type B machines, of 12 sizes, make use of one reduction for heavy-duty work. In the larger sizes, these machines are said to reduce 24-in. cubes to $\frac{1}{4}$ -in. size in one operation. These mills feature self-aligning ball bearings, renewable wearing plates, and adjustable grinding plates.

Short-Center Drive Belt

SHORT-CENTER belt drives are being used extensively in mechanical-power transmission. A belt of the type which does not require an idler pulley has recently been placed on the market under the trade name "Tak-Hold Belting," by the Slip-Not Belting Corporation, Kingsport, Tenn. This belt is of flat leather, designed to run on standard pulleys located on short centers, usually without idlers or tighteners of any kind. The belt consists of an outside ply of the company's "Slip-Not" leather and an inner ply that is perforated at frequent intervals. The two plies are separated by and cemented to a special fabric center which serves as a cushion and muffler. It is claimed that the perforations cause a suction grip on the pulleys and this feature combines with the high coefficient of

friction of the leather to produce the non-slip qualities.

For use with this belt the company has developed the "Uni-Pull" drive. The drive is said to maintain proper tension in the belt at all times by supporting the motor so that part of its weight is taken by the belt. The combination belt and drive is intended to work on applications usually thought of as requiring chains, V-belts or gears.

New Hard-Surfacing Rod

PRODUCTION of surfaces of almost pure tungsten carbide by hard-surfacing with a welding rod is a new development of the Stoddy Company, Whittier, Calif. The rod used in the new process is known as "Borod," and consists of a mixture of unsmelted alloy materials mixed with a suitable binder and held within a soft steel sheath. When the rod is exposed to the heat of the welding arc or gas flame, the sheath melts down and carries with it the alloy content, consisting of metallic tungsten, carbon and other materials. This produces a mixture of tungsten carbide, tungsten-iron alloy, and tungsten-iron-carbon alloy. The alloy is said to fuse completely with the metal to which it is applied. The Rockwell C hardness of the coating is from 65 to 70, equal in abrasion resistance to almost pure tungsten carbide. The resistance of the deposit to checking is reported to be almost equal to that of pure tungsten-iron alloy.

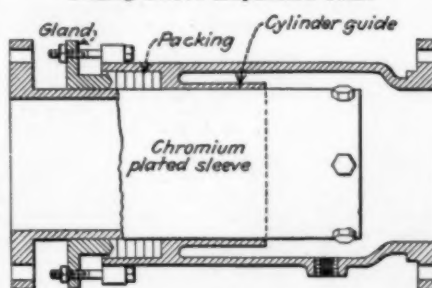
Turbine-Pump Motor

U. S. ELECTRICAL Manufacturing Company, 208 Slauson Avenue, Los Angeles, Calif., has introduced a new motor housing for use on turbine centrifugal pumps requiring vertical motors. None of the operating parts of the motor is exposed and the housing is said to be entirely weatherproof.

Expansion Joint

AN ACCOMPANYING drawing shows one of a new line of cylinder-guided expansion joints which are being made by the Yarnall-Waring Company, 102 East Mermaid Lane, Chestnut Hill, Philadelphia, Pa. These joints are made for pressures of 125 and 250 lb. per square inch, in sizes from $2\frac{1}{2}$ in. to 24 in. in diameter. They are also made

Part-Sectional View of Cylinder-Guided, Sliding-Sleeve Expansion Joint

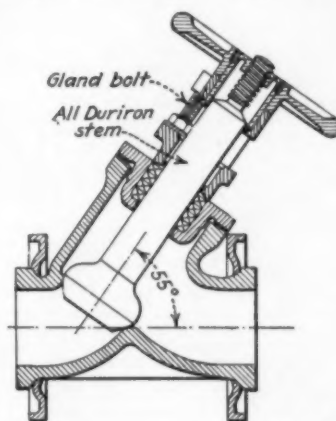


in three styles, the first as shown, the second having the addition of a base and the third consisting of two opposed expansion joints, also with a base. Each type and each size is made with a total possible expansion for each sleeve of 4 in., 8 in. or 12 in.

The joints are made of steel throughout, with the sliding sleeve chromium-plated to preserve the surface and prevent sticking. The guide cylinder is intended to secure positive alignment, while the stuffing box is especially large to provide for ample packing. A dirt pocket is provided in the bottom of each style.

New Y Valve

AN ACCOMPANYING drawing shows a new Y valve which has been developed recently by the Duriron Company, Dayton, Ohio. All parts of the valve which come in contact with the liquid handled are made of Duriron. Special features claimed for the valve include nearly straight flow and full opening; possibility of repacking the



Cross-Sectional View of New Y Valve

valve under pressure while in the closed position; extra long Duriron stem; and gland bolts which bear against the top of the yoke and are hence not exposed to a possible leak from the packing gland. Other features claimed include an extra deep stuffing box; a narrow valve seat which is said to reduce the possibility of the collection of particles on the seat; and reduction of sticking to the minimum. The valve is made in sizes from $\frac{1}{4}$ to 4 in.

Humidifying Unit Heater

BUFFALO Forge Company, Buffalo, N. Y., has added to its line of unit heaters a new machine which washes and humidifies the air before it is heated and discharged into the room. A revolving drum of air washer eliminator and scrubber plates, mounted so as to be partially submerged in a water tank in the base of the heater, is propelled by the air drawn through the unit. These plates continually dip into the water and provide a wetted surface through which the air must pass twice. This is said to remove 70 per cent of

the dust and dirt in the air, and to add about 25 to 35 per cent of moisture to the air. The dirt settles into the washer tank from which it is flushed out periodically. Water level is maintained automatically by means of a float.

The heating portion of the machine makes use of extended-surface steam piping and centrifugal fans similar to those in the other unit heaters made by this company.

Manufacturers' Latest Publications

Acid Tables. Chemical Construction Co., Charlotte, N. C.—Handbook No. 3—Notes on the control of chemical plants and miscellaneous tables on sulphuric-acid plant operation. Also tables on other heavy acids and ammonia. 70 pages.

Bolts. Dardet Threadlock Corp., 120 Broadway, New York, N. Y.—19-page booklet describing Dardet self-locking screw threads.

Buildings. Lockwood Greene Engineers, Inc., 100 East 42nd St., New York, N. Y.—"Building with Foresight," a 64-page booklet, illustrated, listing some of the industrial buildings built by this company.

Buildings. Processed Lumber Co., Elizabeth, N. J.—Folder describing the plant in which this company manufactures processed lumber products.

Chemical Engineering. Swenson Evaporator Co., Harvey, Ill.—Article VIII—Bulletin on "Application of the Forced-Circulation Evaporator," eighth article of a series on "Heat Transfer and Crystallization," by Prof. W. L. Badger. Limited supply of seven previous bulletins by Professor Badger is available.

Chemicals. Eastman Kodak Co., Rochester, N. Y.—List No. 21—January, 1930, price list of all organic chemicals made by this company.

Chemicals. Hercules Powder Co., Wilmington, Del.—51-page booklet giving properties and specifications of the products of this company, including naval stores, nitrocellulose, cotton linters and acids.

Coatings. Quigley Furnace Specialties Co., 56 West 45th St., New York, N. Y.—Folder with color charts describing applications of Quigley Triple-A protective coatings.

Combustion. Air Preheater Corp., Wellsville, N. Y.—Bulletin 120—40 pages with data and illustrations describing the Ljungström air preheater.

Combustion. Lee B. Mettler Co., 406 South Main St., Los Angeles, Calif.—24-page booklet of drawings of installations of this company's gas burner equipment.

Compressors. Chicago Pneumatic Tool Co., 6 E. 44th St., New York—Bulletin 783—Describes a new line of vertical simplex air compressors, type P-6. Bulletin 786 describes vertical duplex air compressors, type P-6-DE. Compressors of both types are for electric or gasoline-engine drives.

Compressors. Ingersoll-Rand Co., 11 Broadway, New York, N. Y.—Form 3,060—Booklet describing a new line of two-stage, self-contained air compressors known as type 30.

Concrete. Philadelphia Quartz Co., Philadelphia, Pa.—Booklet describing the use of silicate of soda in curing concrete.

Condensers. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 4R—8 pages, describing with engineering data condensers for obnoxious vapors.

Control. Braun-Knecht-Heimann Co., 576 Mission St., San Francisco, Calif.—Pamphlet describing the permanent colorimetric pH standards supplied by this company.

Control. Shallcross Control Systems Co., Milwaukee, Wis.—Bulletin No. 100—10 pages, describing the Shallcross system of furnace-draft control.

Disintegration. Williams Patent Crusher & Pulverizer Co., 2701 North Broadway, St. Louis, Mo.—Catalog No. 462—38-page illustrated catalog describing the hammer mills, crushers and complete crushing plants made by this company.

Drying. Philadelphia Drying Machinery Co., Philadelphia, Pa.—Bulletin DA-1—Briefly describes several typical drying installations made by this company.

Duriron. The Duriron Co., Dayton, Ohio.—Price List 15—Net prices on Duriron valves, pipe, fittings, pumps, and miscellaneous parts.

Dust Collection. By-Products Recoveries, Inc., 34 Cliff St., New York, N. Y.—Bulletin 428—Describes barbed-plate type collectors for dry dusts.

Electrical Equipment. Crouse-Hinds Co., Syracuse, N. Y.—Bulletin 2203, plugs and receptacles for high frequency tools; and bulletin 2204, interlocking-safety-switch conduits.

Electrical Equipment. Electric Controller & Manufacturing Co., Cleveland, Ohio.—Folder describing briefly time-current controls for electric motors.

Electrical Equipment. Engberg Division, Troy Engine & Machine Co., St. Joseph, Mich.—Bulletin 106—15-page bulletin describing steam-engine-driven generating sets for direct current.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-570B, hand starting compensator; GEA-714B, MD-400 d.-c. mill motors; GEA-874E, type WD-200A arc welder; GEA-875E, type WD-300A arc welder; GEA-876D, type WD-400A arc welder; GEA-881C, continuous gas-engine-driven, type WD-200A arc welder; GEA-962A, A.-c. controllers; GEA-987A, station oil circuit breakers; GEA-1009B, gas-engine-driven, type WD-300A arc welder; GEA-1142A, type EW resistors; GEA-1158A, determining cost of operating electric appliances and motors; GEA-1164, group operated disconnecting switches; GEA-1173, oil circuit breakers; GEA-1191, 85 pages on synchronous motors; GEA-1192, beam clamps; GEA-1193, automatic switching equipment; GEA-1198, MD-400 motor sales; GED-359, outstanding G. E. achievements of 1929; GET-191, solving industrial power factor problems by scale.

Electrical Equipment. U. S. Electrical Manufacturing Co., 200 East Slauson Ave., Los Angeles, Calif.—Form 575—Folder describing the fire-resistant features of the motors made by this company.

Electrical Equipment. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—36-page booklet describing "Engineering Achievements of the Westinghouse Electric & Manufacturing Co. During 1929."

Equipment. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—Leaflets 20435 and 20442, describing, respectively, jet condensers and an oil purifier combining a centrifuge and a filter press.

Feeder. The Hardinge Co., York, Pa.—Bulletin 33—Describes the new Hardinge constant weight feeder for weighing and feeding materials.

Grinding. Patterson Foundry & Machine Co., East Liverpool, Ohio.—Reprint of an address concerning grinding equipment in the paint industry.

Heat Exchangers. Griscom-Russell Co., 285 Madison Ave., New York, N. Y.—Form No. 463—Briefly describes waste-heat recovery from liquids and gases in industrial plants by means of different types of heat exchangers.

Instruments. The Bristol Co., Waterbury, Conn.—Catalog 1009—Complete information on charts and instruments for recording pressure and vacuum.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 1229—12 pages, describing the use of graphic instruments in continuous plant surveys.

Instruments. The Foxboro Co., Foxboro, Mass.—Folder announcing a new steam flowmeter made by this company.

Instruments. Fulton Syphon Co., Knoxville, Tenn.—Bulletins 125, 150 and 175.—Describing, respectively, automatic temperature control of liquids, refrigerating systems, and air and gases. The bulletins are, respectively, 23, 8 and 15 pages in length.

Instruments. Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.—Leaflets describing a pyrometer checking and calibrating set and a double-strip-chart pyrometer recorder for two to six records.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Three bulletins briefly describing automatic control of acid baths, automatic integration of steam temperature, and the quinhydrone pH indicator.

Instruments. Weston Electrical Instrument Corp., Newark, N. J.—Bulletin 4,800—Completely describes the principle and application of the Weston heat-flow meter.

Material Handling. H. W. Caldwell & Son Co., 2,410 West 18th St., Chicago, Ill.—Book 1,086—24 pages describing driving equipment for bucket elevators, complete with data and illustrations.

Metals and Alloys. Chase Brass & Copper Co., 80 Lafayette St., New York, N. Y.—Stock list No. 5—Complete stock list of sheets, tubing, pipe, wire, etc., in brass, copper and bronze.

Metals and Alloys. The Duraloy Co., Pittsburgh, Pa.—Bulletin 3,012—8 pages, describing the uses of chromium and chromium-nickel steels, giving also a summary of the properties of different alloys of these classifications.

Paper. Cameron Machine Co., 61 Poplar St., Brooklyn, N. Y.—Form 10-720—Describes type 10, model 10 slitting and winding machines for paper.

Paper. The Emerson Manufacturing Co., Lawrence, Mass.—Folder describing the Loiton inverted-wedge plug for Jordan engines.

Paper. Technical Economist Corp., 122 East 42nd St., New York, N. Y.—Bulletins 304 and 305—Describe, respectively, the Merritt Board Dryer, 9 pages, illustrated, and the M-M Stock Consistency Regulator, both marketed by this company.

Plating. New Jersey Zinc Co., 160 Front St., New York, N. Y.—12-page research bulletin describing procedure and solutions for plating on rolled zinc and zinc-base die castings.

Power Transmission. Allis-Chalmers Manufacturing Co., Milwaukee, Wis.—General Bulletin 1228-K—28-page illustrated booklet covering applications of Texrope drives.

Power Transmission. Hill Clutch Machine & Foundry Co., 6,400 Breakwater Ave., Cleveland, Ohio.—Catalog 29A—Describes bearings, bearing supports, shafts, collars, and couplings with prices and dimensions.

Power Transmission. S. S. White Dental Manufacturing Co., Industrial Division, 152 West 42d St., New York, N. Y.—119-page flexible-shaft handbook, describing applications of flexible shafts up to $\frac{3}{4}$ in. in diameter.

Pumps. Beach-Russ Co., 50 Church St., New York, N. Y.—Bulletin No. 39—Gives sizes, capacities and descriptions of the line of vacuum and pressure pumps and compressors made by this company.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 200—Complete selection charts for determining pumps and motor drives for any service. Also describes the single-stage, double-suction pumps made by this company. 40 pages.

Pumps. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin 214—Describes briefly the double-suction, single-stage centrifugal pumps made by this company.

Pumps. Taber Pump Co., 288 Elm St., Buffalo, N. Y.—Folder describing pumps for sulphuric and nitric acids and caustic soda.

Refractories. Harbison-Walker Refractories Co., Pittsburgh, Pa.—Handsomely illustrated book of 178 pages entitled "Modern Refractory Practice." The book describes very completely the entire line of refractories, clay products and cements made by this company and includes a comprehensive discussion of the use of refractories in various industries. Many formulas and tables useful in the application of refractories and brick, some of which have never been published before, a section on miscellaneous information, and a glossary of terms used in the refractories industry, complete the book.

Safety. Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y.—26-page bulletin describing an investigation of the accident-prone employee, made by the Cleveland Railway Co.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.—Publications as follows: Catalog MR-2, multiple retort underfeed stokers; bulletin BVM-1, VM type boilers; also booklet describing the steam generating units at the East River station of the New York Edison Co., said to be the largest units in the world.

Valves. Merco Nordstrom Valve Co., 343 Sansome St., San Francisco, Calif.—New catalog describes Nordstrom valves in various sizes for pressures up to 1,500 lb. Also includes tables and information on lubricants for valves.

Welding. Lincoln Electric Co., Cleveland, Ohio.—"Plates 10 and 11" of a series of studies in structural arc welding.

Welding. Linde Air Products Co., 30 East 42d St., New York, N. Y.—Two treatises of interest to the welding engineer: "Oxwelded Construction for Modern Piping Services," a 77-page booklet, with considerable information on all principal kinds of piping; "Fabrication of Welded Piping Designs," 86 page booklet, well illustrated, describing actual procedure in pipe welding. Making of templates and cost estimation are included.

PATENTS ISSUED

Dec. 17, 1929 to Jan. 28, 1930

Paper, Pulp, Glass and Sugar

Process of Making Plastic Compositions. Edwin Potter Carpenter, Horley, England, assignor to American Machine & Foundry Company.—1,740,573.

Process of Manufacturing Sugar. Milton S. Hershey, Hershey, Pa.—1,740,693.

Cellulose-Acetate Composition. William Gump, Newark, N. J., assignor of 40 per cent to John C. Dehls and 40 per cent to Leo Stein.—1,740,854.

Coloring of Products Comprising Cellulose Acetate. George Holland Ellis, Spondon, near Derby, England, assignor to Celanese Corporation of America.—1,740,890.

Apparatus for Making Composite Glass. William O. Lytle, New Kensington, Pa., assignor to Pittsburgh Plate Glass Company.—1,740,989.

Process for the Production of High-Alpha Cellulose Fiber for the Manufacture of Cellulose Derivatives. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,741,540.

Pulp or Fiber Thickener. Albert D. Wood, Canton, N. C.—1,742,294.

Fourdrinier Paper Machine. Alonzo Aldrich, Beloit, Wis.—1,742,337.

Manufacture of Pulp and Treatment of Residual Liquors, etc. Linn Bradley, Montclair, N. J., and Edward P. McKee, Plattsburg, N. Y., assignors to Bradley-McKee Corporation, New York, N. Y.—1,743,080.

Method and Apparatus for Concentrating and Evaporating Sugar Syrups. George Ralph Baker and William Edward Prescott, Willesden Junction, London, England, assignors to Baker Perkins Company Incorporated, New York.—1,744,096.

Glass-Melting Furnace. Wilbur F. Brown, Toledo, Ohio, assignor to Libbey-Owens Glass Company, Toledo, Ohio.—1,744,359.

Method and Apparatus for Producing Plate Glass. John L. Drake, Toledo, Ohio, assignor to Libbey-Owens Glass Company, Toledo, Ohio.—1,744,372.

Fourdrinier Machine. George D. Kilberry, Downingtown, Pa., assignor, by mesne assignments, to Beloit Iron Works, Beloit, Wis.—1,743,970.

Rubber, Rayon and Synthetic Plastics

Manufacture of Condensation Products. Richard Michel, Uerdingen, Niederrhein, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,741,472-3.

Rubber Composition and Method of Preparing Rubber. Paul C. Jones, Cuyahoga Falls, Ohio, assignor to B. F. Goodrich Company, New York, N. Y.—1,741,778.

Process for the Production of High-Alpha Cellulose Fiber. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,742,218-9.

Method of Preparing Condensation Products of Acetylene and Phenols. Conrad F. Schrimpe, Woodbridge, N. J., assignor to Bakelite Corporation, New York, N. Y.—1,742,519.

Coating and Method of Manufacturing the Same. Nicholas J. Shields, San Luis Obispo, Calif., assignor of one-half to John W. Cushing, San Francisco, Calif.—1,742,520.

Liquid Coating Composition. Camille Dreyfus, London, England, assignor to Celanese Corporation of America.—1,742,587.

Treatment of Rubber and Products Obtained Thereby. John McGavack, Jackson Heights, N. Y., assignor to Naugatuck Chemical Company, Naugatuck, Conn.—1,742,609.

Method of Treating Mercerizing Solution. William H. Eggert, Buffalo, N. Y., assignor to Zaremba Company, Buffalo, N. Y.—1,743,122.

Vulcanization of Rubber. Winfield Scott, Akron, Ohio, assignor to Rubber Service Laboratories Company, Akron, Ohio.—1,743,243.

Product and Process for Rubber Compounding. Arthur B. Cowdery, Needham, Mass., assignor to Barrett Company.—1,743,433.

Soluble and Fusible Synthetic Resin and Process of Making the Same. William Henry Moss, Cumberland, Md., assignor to Celanese Corporation of America, New York, N. Y.—1,743,680.

Celluloid Molding Powder and Process for Producing the Same. Earle B. Scott, Verona, N. J., assignor, by mesne assignments, to Toledo Automatic Brush Machine Company, Toledo, Ohio.—1,744,582.

Coating. Edward C. Haines, Parlin, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,744,699.

Dispersed Rubber Isomer. Harlan L. Trumbull, Hudson, Ohio, assignor to B. F. Goodrich Company, New York, N. Y.—1,744,844.

Paint and Method of Making the Same. William C. Geer, New Rochelle, N. Y., assignor to B. F. Goodrich Company, New York, N. Y.—1,744,881.

Rubber-Latex Cement and Method of Preparing the Same. Bradley Dewey, Cambridge, and Ernest C. Crocker, Belmont, Mass.; said Crocker assignor to said Dewey.—1,745,084.

Petroleum Refining and Products

Refining of Hydrocarbon Oils. Robert Henry Gardner and Howard George Hodge, Coffeyville, Kan., assignors to Sinclair Refining Company, New York, N. Y.—1,740,584.

Refining of Hydrocarbon Oils. Harry L. Pelzer, Highland, Ind., assignor to Sinclair Refining Company, New York, N. Y.—1,740,625.

Apparatus and Process of Treating Hydrocarbon Oils. Charles J. Greenstreet, New York, N. Y., assignor to Gasoline Corporation.—1,740,691.

Art of Conversion of Hydrocarbon Oils. Edward E. Bartels, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,741,045.

Process of Fractionating Vapors From Pressure Stills and the Like. John E. Bell, Brooklyn, N. Y., assignor to Sinclair Refining Company, Chicago, Ill.—1,741,275-77.

Art of Cracking Hydrocarbons. John E. Bell, deceased, Brooklyn, N. Y., by Lola R. Bell, executrix, Brooklyn, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,741,277.

Art of Cracking Hydrocarbons. John E. Bell, Brooklyn, N. Y., assignor to Sinclair Refining Company, Chicago, Ill.—1,741,357.

Process for Converting Petroleum. Gustav Egloff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,741,509-10.

Dephlegmator or Fractionating Column. Lyman C. Huff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,741,519.

Hydrocarbon-Oil Conversion. Clifton J. Pratt, Tulsa, Okla., assignor to Universal Oil Products Company, Chicago, Ill.—1,741,535.

Process of Purifying Petroleum Distillates. Marvin L. Chappell, Inglewood, and George J. Ziser, Los Angeles, Calif., assignors, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,741,555.

Art of Coking Oils. Daniel R. Weller and Louis Link, Baton Rouge, La., assignors to Standard Oil Development Company.—1,741,895.

Process for Treating Mineral Oils. Albert H. Ackerman, Chicago, Ill., assignor to Catalytic Chemical Company.—1,742,020-1.

Method of Producing Gasoline From Cracked Distillate. George P. Koch, Martinez, Calif., assignor to Shell Oil Company, San Francisco, Calif.—1,742,263.

Separating Oil Emulsions. George W. Coggeshall and Arthur Reilly, Washing-

ton, D. C., assignors to Jefferson Construction & Oil Treating Company, Washington, D. C.—1,742,648.

Process of Converting Hydrocarbons and Mineral Oils Having a High Boiling Point Into Those Having a Lower Boiling Point. Hermann Wolf, Bad Homburg, Germany, assignor to Carburol Aktiengesellschaft, Schaffhausen, Switzerland.—1,742,888.

Process of Mineral-Oil Distillation. Arthur E. Pew, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa.—1,742,933.

Recovery of Gasoline. Harold B. Bernard, Tulsa, Okla., assignor to Sinclair Oil & Gas Company, Tulsa, Okla.—1,743,185.

Wax Sweating and Crystallizing Apparatus. Hugh Logie Allan and James Moore, Burma, British India, assignors to the Burmah Oil Company, Ltd., Glasgow, Scotland.—1,743,746.

Process for Converting Hydrocarbon Oils. Carbon P. Dubbs, Wilmette, and Jacque C. Morrell, Chicago, Ill.; said Dubbs assignor to Universal Oil Products Company, Chicago, Ill.—1,744,109.

Process and Apparatus for Fractional Distillation. Maurice B. Cooke, Plainfield, N. J., assignor to Atlantic Refining Company, Philadelphia, Pa.—1,744,261.

Process and Apparatus for Treating Petroleum Oils. Walter M. Cross, Kansas City, Mo.—1,744,262.

Fractional Distillation. William F. Stroud, Jr., Moorestown, N. J., and Richard B. Chillas, Jr., Philadelphia, Pa., assignors to Atlantic Refining Company, Philadelphia, Pa.—1,744,421.

Apparatus for Reactivating Charcoal. Charles N. Whitaker, Wilmington, Calif., assignor to Shell Company of California, San Francisco, Calif.—1,744,429.

Process of Cracking Mineral Oil. John Howard Pew, Ardmore, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,744,574.

Removal of Petrolatum from Hydrocarbon Oils. Robert S. Lane and Samuel A. Montgomery, Wood River, Ill., assignors to Standard Oil Company, Whiting, Ind.—1,744,648.

Coal and Organic Products

Gas Purification. David L. Jacobson, Pittsburgh, Pa., assignor to Koppers Company.—1,741,113.

Purification of Aromatic Hydrocarbons. Alphons O. Jaeger, St. Louis, Mo., assignor to Selden Company, Pittsburgh, Pa.—1,741,305.

Chlorination. Eugene E. Ayres, Jr., Swarthmore, Pa., assignor to B. A. S. Company, Philadelphia, Pa.—1,741,393.

Purification of Ethylene. Howard H. Dawson, Cleveland, Ohio, assignor to Ohio Chemical & Manufacturing Company, Cleveland, Ohio.—1,741,559.

Discontinuous Distillation of Tars. Leopold Kahl, Berlin-Dahlem, Germany.—1,742,258.

Purification of Benzol, Petrol, and the Like. Kenneth Cox and Percival John McDermott, Parsonage, England, assignors to Refiners, Ltd., Manchester, England.—1,742,343.

Activated Charcoal. Franz Milk, Kreuzlingen, Switzerland, assignor to Holzverkohlungs-Industrie Aktiengesellschaft, Constance, Germany.—1,743,975.

Fertilizer Manufacturer. Herbert H. Meyers, Pittsburgh, Pa., assignor to Armour Fertilizer Works, Chicago, Ill.—1,742,448.

Metal Salts of Phthalic Esters. Clarence I. B. Henning and Charles E. Burke, Wilmington, Del., and Ebenezer Emmet Reid, Baltimore, Md., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,742,506-9.

Method for Treating Hides. David L. Levy, Lynn, Mass.—1,742,514.

Production of Organic Compounds Containing Oxygen. Paul Herold and Hellmuth Langheinrich, Neurossen, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt, Germany.—1,743,214.

Gas Cleaner. Charles Gilbert Hawley, Chicago, Ill., assignor to Centrifix Corporation, Cleveland, Ohio.—1,743,344.

Apparatus for Treating Carbonaceous Material. William Rhoades, San Leandro, Calif.—1,743,394.

Gas Purification Process. Charles J. Ramsburg, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,743,479.

Process of Treating Skins or Hides Previous to Tanning. William H. Allen, Detroit, Mich., assignor to Leather Makers Process Company, Detroit, Mich.—1,743,647.

Manufacture of Acetic Acid. Henry Dreyfus, London, England.—1,743,659.

Combustible-Gas Generator. Willis J. Murdock, Joliet, and Edgar E. Lungren, Aurora, Ill., and Owen B. Evans, Philadelphia, Pa., assignors, by mesne assignments, to Pier Process Corporation, Aurora, Ill.—1,743,724-6.

Producer-Gas Process. Heinrich Koppers, Essen-Ruhr, Germany, assignor to Koppers Development Corporation, Pittsburgh, Pa.—1,743,717.

Process of Making Producer Gas. Harald Nielsen, Muswell Hill, London, and Bryan Laing, Hatfield, England.—1,743,930.

Process of Producing Alkyl Sulphates. Robert M. Isham, Okmulgee, and Sidney Born, Tulsa, Okla., assignors, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y.—1,744,164.

Process of Treating Organic Substances in Liquid State Electrochemically. Carlo Longhi, Milan, Italy.—1,744,173.

Process for the Purification of Synthetic Methyl Alcohol. Eduard Tschunkur and Albert Klamroth, Cologne-Mulheim, Germany, assignors to I. G. Farbenindustrie, Frankfurt, Germany.—1,744,180.

Process of Producing Alkyl Sulphates and Alcohols Therefrom. Sidney Born, Bartlesville, and Robert Melyne Isham, Okmulgee, Okla., assignors, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y.—1,744,207.

Production of Dialkyl Sulphates. Robert M. Isham, Okmulgee, Okla., assignor, by mesne assignments, to Seth B. Hunt, trustee, Mount Kisco, N. Y.—1,744,227.

Process of Making Formaldehyde. Harry W. Ahlbeck, Riverside, Ill., assignor to Bakelite Corporation, New York, N. Y.—1,744,295.

Process of Manufacture of Absolute Alcohol. Elol Ricard, Melle, France, assignor, by mesne assignments, to U. S. Industrial Alcohol Co., New York, N. Y.—1,744,503-4.

Process for the Conversion of Triglycerides With Other Esters. Christiaan van Loon, Dordrecht, Netherlands, assignor to Naamlooze Vennootschap Anton Jurgens Margarinefabrieken, Nijmegen, The Netherlands.—1,744,596.

Fermentation Process for Producing Acetone and Butyl Alcohol. George W. Freiberg, St. Louis, Mo.—1,744,958.

Process of Making Diphenyloxide and the Like. William J. Hale, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,744,961.

Process of Converting Gaseous Aliphatic Ethylene Hydrocarbons Into Liquid Hydrocarbons. Elol Ricard, Melle, France, assignor to Societe Ricard, Allenet & Cie., Melle, Deux-Sevres, France.—1,745,028.

Inorganic Products

Nitric-Acid Concentration. Ralph H. McKee, Leonia, N. J., assignor to Southern Electro-Chemical Company, New York, N. Y.—1,740,549.

Preparation of Sulphate of Ammonia. Stanley Robson, Avonmouth, England.—1,740,837.

Process for the Production of Metallic Beryllium. Wilhelm Kroll, Luxemburg, Luxemburg.—1,740,857.

Process of Reducing Products of Carbon Monoxide. Alphons O. Jaeger, Crafton, Pa., assignor to Selden Company, Pittsburgh, Pa.—1,741,306-8.

Contact Sulphuric Acid Process. Alphons O. Jaeger, Crafton, Pa., assignor to Selden Company, Pittsburgh, Pa.—1,741,310.

Recovery of Sulphurous Acid From Waste Gases. Christian Hansen, Wiesdorf-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany.—1,740,342.

Method of Producing Elemental Sulphur. Raymond C. Benner, Niagara Falls, and Alfred Paul Thompson, Jackson Heights, N. Y., assignors to General Chemical Company, New York.—1,741,551.

Process of Producing Cyanamid. George Barsky, New York, N. Y., and Palmer W. Griffith, Elizabeth, N. J., assignors to American Cyanamid Company, New York.—1,741,674.

Process for Liquefying Oxides of Nitrogen. Christoph Beck, Ludwigshafen, and Heinrich Diekmann, Mannheim, Germany,

assignors to I. G. Farbenindustrie, Frankfurt, Germany.—1,741,906.

Refractory Composition and Method of Making. Thomas S. Curtis, Huntington Park, Calif., assignor to Vitrefax Company, Los Angeles, Calif.—1,741,920.

Process of Making Fused Cement. Bruno Bruhn, Bethlehem, Pa., assignor to G. Polysius, Dessau, Germany.—1,741,973.

Method of Treating Minerals Containing Potassium, Aluminum, and Iron. Charles E. Arnold, Odessa, Del., assignor to Electro Company, Odessa, Del.—1,742,191.

Method of Separating Tin Compounds From Solutions. Henry M. Schleicher, Monterrey, Mexico, assignor to American Metal Company, Ltd., New York, N. Y.—1,742,284.

Production of Basic Aluminum Sulphate. Chester C. Feagley, Philadelphia, Pa., assignor, by mesne assignments, to Grasselli Chemical Company, Cleveland, Ohio.—1,742,345.

Titanium Oxide and Process of Producing Same. Foord von Bichowsky, Glendale, Calif., assignor to Titania Corporation, Los Angeles, Calif.—1,742,674.

Low-Velocity Ammonia Dynamite. William H. Ward, Parkside, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,743,172.

Process of Treating Aluminum with Halogen Gases. Robert J. Anderson, Fairmont, W. Va., assignor to Fairmont Manufacturing Company, Fairmont, W. Va.—1,743,515.

Copies of Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Photostatic copies of foreign patents may be obtained at the same address, prices being forwarded on application.

Method of Making Anhydrous Zinc Chloride by Reacting Zinc Oxide With Chlorine. Conway von Grisevald and Hans Neumark, Frankfurt-on-the-Main, Germany.—1,743,740.

Zinc Oxide and Manufacture Thereof. Earl C. Gaskill, Red Bank, N. J., assignor to St. Joseph Lead Company, New York, N. Y.—1,743,964.

Method of Separating Alkali-Earth Metal Phosphates From Primary Alkali Phosphate Solutions. Fritz Dralsbach, Ludwigshafen-on-the-Rhine, Germany, assignor to the Firm Joh. A. Benckiser Chemische Fabrik, Ludwigshafen-on-the-Rhine, Germany.—1,744,371.

Refractory Material. Alexander Hasselbach, Dessau, Germany, assignor to the Firm G. Polysius, Dessau, Germany.—1,744,547.

Calorimetric Bomb for the Catalysis of Ammonia. Giovanni Cicali, Bologna, Italy, assignor to Societa Brevetti Cicali, Anonima, Padova, Italy.—1,744,750.

Method of Purifying Zinc Chloride. James L. McClellan, Kennett Square, Pa., assignor to National Vulcanized Fibre Company, Wilmington, Del.—1,744,981.

Chemical Engineering Processes and Equipment

New Type of Electrolytic Cell. Ralph L. MacDonald, Niagara Falls, N. Y.—1,740,659.

Catalytic Apparatus. Alphons O. Jaeger, Crafton, Pa., assignor to The Selden Company, Pittsburgh, Pa.—1,741,309.

Filter. Kurt F. Pietzsch, Pittsburgh, Pa., assignor, by mesne assignments, to Selden Research & Engineering Corporation, Pittsburgh, Pa.—1,741,334.

Centrifugal Machine. Wilmer H. Bath, West Conshohocken, Pa., assignor to Sharples Specialty Company, Philadelphia, Pa.—1,741,397.

Conveyor. Fred A. Hansen, Milwaukee, Wis., assignor to Hevi Duty Electric Company, Milwaukee, Wis.—1,741,624.

Method and Apparatus for Utilizing Waste Heat. Herman B. Smith, Plainfield, N. J., assignor to Babcock & Wilcox Company, Bayonne, N. J.—1,741,663.

Filter. Robert P. F. Liddell, New York, N. Y., assignor to Motor Improvements, Inc., Newark, N. J.—1,741,705.

Electric Furnace. Cornelius Eric Cornelius, Stockholm, Sweden.—1,741,977.

Drying Oven. Kenneth James Rennie Robertson and Alexander Fowler, London, England, assignors to Carrier Engineering Company Limited, London, England.—1,742,099.

Packing Ether for Storage, Shipment, and Sale. John Truman Glekler, Cleveland, Ohio, assignor to Ohio Chemical & Manufacturing Company, Cleveland, Ohio.—1,742,206-7.

Process for the Separation or Recovery of Gases and Vapors by Solid Adsorbents. Albert Godel, Lagnieu, France, assignor to Societe de Recherches et d'Exploitations Petroliferes, Paris, France.—1,742,247.

Retort. Lars G. Nilson, Hoboken, N. J., assignor to International Bitumenol Corporation.—1,742,273.

Electrical Furnace. Harold N. Shaw, Milwaukee, Wis., assignor, by mesne assignments, to Globar Corporation, Niagara Falls, N. Y.—1,742,286.

Porous Molded Body to Be Used in Diffusion, Filtration, Etc., and Process for Making the Same. Josef Muller, Weissenstein-on-the-Drau, Karnten, Austria, assignor to the Firm Schumacher'sche Fabrik G. m. b. H., Stuttgart, Germany.—1,742,411.

Method of Treating Filtering Materials. John V. Apablaza, Los Angeles, Calif., assignor to O. J. Salisbury, Salt Lake City, Utah.—1,742,433.

Drying Kiln. Robert De Reytere, Courcelles Motte, Belgium.—1,742,586.

Centrifugal Machine. Paul Boehm, Gortitz, Germany.—1,742,643.

Heat Exchanger. Henry Thomas, Ridley Park, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,742,833.

Filter Press. George Cooper, Leeds, England, assignor to Joshua Tetley & Son, Ltd., Leeds, England.—1,743,117.

Method of and Means for Providing Inert Atmospheres. Charles A. Styer, Wilkesburg, Pa., assignor to Westinghouse Electric & Manufacturing Company.—1,743,167.

Apparatus for Distilling Liquids. Walter E. Sanger, Chicago, Ill.; Union Trust Company, Detroit, Mich., executor of the said Walter E. Sanger, deceased, assignor to Oscar H. Wurster.—1,743,289.

Process for Distilling Liquids. Walter E. Sanger, deceased, Chicago, Ill., by Union Trust Company, executor, Detroit, Mich., assignor to Oscar H. Wurster, Chicago, Ill.—1,743,488.

Filtering Medium. Charles T. Cabrera, New York, N. Y., assignor to Electro Dialyzer Corporation, New York, N. Y.—1,743,525.

Viscosity Regulator. Francisco Angel Quiroz, New York, N. Y., and John Pollock Leask, Glenbrook, Conn., assignors to Peabody Engineering Corporation.—1,743,620.

Apparatus for Pumping Viscous Fluids. Gunnar C. Engstrand, New York, N. Y., assignor, by mesne assignments, to Salvage Process Corporation, New York, N. Y.—1,743,761-2.

Liquefaction Apparatus. John W. Davis, Fort Worth, Tex., assignor to Samuel G. Allen, trustee.—1,744,108.

Attrition Mill. Jonathan Markley and Edward M. Brennan, Springfield, Ohio, assignors to Bauer Brothers Company, Springfield, Ohio.—1,744,235.

Fluid Separator. George M. Kirkpatrick, Pittsburgh, Pa., assignor, by mesne assignments, to Blaw-Knox Company, Blawnox, Pa.—1,744,314.

Combined Purifying and Distilling Apparatus. Kurt E. Buettner, Dallas, Tex.—1,744,747.

Desiccating Apparatus. Arthur H. Harvey, Elizabeth, N. J., assignor to Bowen Research Corporation, Westfield, N. J.—1,745,168.

Zeolite and Method of Making Same. Svein Dahl-Rode, Philadelphia, Pa., assignor to Cochrane Corporation, Philadelphia, Pa.—1,745,337.

NEWS of the Industry

Consumers Oppose Change in Alcohol Permits

ALTHOUGH the alcohol-using trades have not sought to obstruct the administration's program for transferring prohibition enforcement from the Treasury Department to the Department of Justice, they desire definite assurance that in the process, the permit regulations, developed by ten years' of experience in the administration of the permissive features of the law, will not be lightly revised or discarded. Their apprehension on this score has not been allayed by the fact that although the diversion of industrial alcohol has dwindled to a mere trickle, it has been made the target for concerted attack on the present state of prohibition enforcement.

Claiming that they did not have a full opportunity to be heard by the House committee in charge of the Williamson bill, representatives of the legitimate industry now insist that they should be consulted on the new regulations that, under the Williamson bill, would be promulgated jointly by the Secretary of the Treasury and the Attorney General. To the industry it is a question whether past experience will be heeded or whether it will have to start again with a new set of regulations and repeat the tedious process of piecemeal revision. Although the terms of the Williamson bill require that a new body of regulations must be drawn up, an amendment was inserted providing that existing provisions may be retained that are not in conflict with specific terms of the bill.

While there is little objection to vesting in the Attorney General power to veto applications for permits, the requirement that no permit shall be granted, renewed or amended for a period of 10 days after copy of the application has been forwarded from the Treasury Department to the Department of Justice is regarded as unreasonably burdensome. While 90-day permits have been exempted from this provision, thus freeing applications made for withdrawals, applications for supplemental permits, which frequently require prompt handling, would not fall into this excepted category except in cases where the basic permit, to which the supplemental permit is an amendment, has only three months to run before expiration. Wholesale druggists are particularly concerned by this restriction. They explain that obtaining approval for a new formula some-

times is an urgent matter in which a life may be at stake.

Passed by the House on Feb. 8, without a record vote, the Williamson bill has been referred to the Senate Judiciary Committee. The alcohol-using trades are hopeful that they will be accorded a hearing by that committee on various features of the bill that in their opinion require further refinement.

Hartford Members of A.S.S.T. Hear Address on Steel

CORROSION resisting steels was the subject of F. R. Palmer's address given before the Hartford Chapter of the A.S.S.T. at the February meeting. The talk was designed to show why corrosion-resisting steels have the composition which they do; how they can be subdivided into three simple groups and how the properties and behavior can be forecast from the group characteristics. The speaker said that one of the most interesting and useful modifications of chromium irons is in a new free machining grade which contains about 0.40 per cent zirconium sulphide. This metallic sulphide confers upon the finished parts anti-frictional properties which avoid to a large extent galling, scratching, and seizing in finished parts such as high-temperature gate valves, bolts and nuts, pump shafts, and other parts subject to moving contact under high pressure.

Dayton Process Oil Gas Plant in Operation

LAST YEAR, the General Oil Gas Corporation, installed a 6,000,000 cu.ft. per day Dayton Process oil gas plant for the Union Natural Gas Company of Canada, Ltd., at Windsor, Ontario. The plant was completed, ready for operation, during November, when a sudden cold snap set in and caused an extreme peak-load demand on the natural gas system. The sudden increased line pressures resulted in a break in one of the transmission lines.

The Dayton oil gas plant was as a result called upon to commence operation at very short notice, and to furnish oil gas during this period at the rate of 2½ million cubic feet per day. This gas was actually being introduced into the plant in less than an hour from the time word was received at that point.

Alloy Steel Makers Form Sales Organization

FORMATION of a new steel company, Associated Alloy Steel Company, Inc., was announced Feb. 11, jointly by M. T. Lothrop, president, Timken Roller Bearing Company; Severn P. Ker, president, Sharon Steel Hoop Company, and H. G. Batcheller, vice-president, Ludlum Steel Company.

The company has been incorporated to sell exclusively corrosion-, heat- and wear-resisting alloy steels produced by the Timken, Sharon and Ludlum companies. These products include Nirosta, Nitralloy and Stainless steels.

The active management will be under the direction of David B. Carson, vice-president and treasurer, formerly sales manager, development division, Central Alloy Steel Corporation. Headquarters of the company will be located at Cleveland, Ohio, and branch offices and warehouses established in strategic centers throughout the country. Mill facilities are being expanded and additional equipment for the most recent production practices is already installed.

Mr. Batcheller, president of the new company, made the following statement to the press: "We feel that Associated Alloy Steel Company meets a very definite need in the alloy steel situation, providing at once the co-ordinated production of these materials in all forms under the finest supervision and metallurgical research and a centralized source of supply from which customers may obtain the varied forms necessary to meet their requirements. It provides greater efficiency in engineering and servicing and the economy in marketing necessary to supply materials at the lowest possible price."

Colby Heads Compressed Gas Manufacturers

AT THE annual meeting and dinner of the Compressed Gas Manufacturers' Association, held at the Hotel Astor, New York, on Jan. 28, officers for the ensuing year were elected. As a result of the election, J. R. Colby, of Canadian Carbonate, Ltd. will officiate as president for the coming year. Other officers include E. C. Turner, of the Air Reduction Company, first vice-president; H. W. Cole, of the Liquid Carbonic Corporation, second vice-president and F. R. Fetherston, secretary and treasurer.

Naval Stores Rules Meet With Approval

REVUE of the Federal Trade Commission of the code of trade practices adopted last June by the steam solvent class of the naval stores industry has resulted in affirmative approval of four rules condemning price discrimination, secret rebates, interference with contracts, and misrepresentation as unfair methods of competition violative of the law. Six other rules have been accepted by the Commission as an expression of the trade on proposals for the correction of practices regarded as economically unsound that are not susceptible to definition as unfair methods of competition for governing the marketing of them. Seven other rules proposed by the steam solvent products were rejected outright by the Commission.

More significance attaches to the rules rejected than to those accepted by the Commission, because the latter conform to principles fairly well established, while the former propose means that, in practice, the Commission presumably regards as tending toward restraint of trade. The Commission rejected a resolution approving distribution by each producer of his current price lists, including terms of sale and all subsequent changes when made. When this resolution was adopted, Commissioner G. S. Ferguson, who presided at the conference, explained that the Commission "could not record or give its approval to a resolution which might be a vehicle for violation of the law." He said that "while in itself it may not be a violation of the law to circulate current price lists, it could very easily be the means upon which prices could be fixed in an industry."

The Commission also rejected a rule adopted by the conference providing that each producer should furnish the Institute with an outline of his sales policy showing terms, quantity discounts or differentials, and providing that the producer shall not deviate from this policy in any particular without immediately reporting the change to the Institute. This resolution also provided that each producer should furnish a list of his sales offices, authorized distributors and agents, and stated that "the members of the Institute agree that selling any authorized distributor, or agent of another member, without said member's consent, is hereby condemned." Commissioner Ferguson had remarked at the conference that there was the same objection to this resolution as to that approving distribution of current price lists, declaring that "it smacks very much of the combination in restraint of trade for one thing, and it also looks like a method of eliminating competition."

Among the chemical industries that have applied for trade practice conferences under the Federal Trade Commission are the bleached shellac manufacturers and the solvents group. The

conference dates have not been set. One of the latest applicants is the paper can, tube, and drum industry, which will participate in a meeting to draft rules governing trade ethics in the production of set-up paper boxes, a yearly business of \$106,000,000. Set-up boxes differ from folding boxes in that they are made ready for use and are not to be flattened for shipment. The candy box is one example, though many types of wound paper cartons are included.

Petroleum Producers Seek Tariff Protection

ALARGE group of independent oil producers appeared before the House Committee on Ways and Means Feb. 8 to urge a tariff of \$1 per barrel on crude oil and 50 per cent ad valorem on refined products. Wentworth Franklin, of Ardmore, Okla., president of the Independent Petroleum Association of America, appeared as spokesman for a delegation of more than 250 members of the industry. He urged protection for oil comparable with that accorded other great industries of the nation, pointing out that the oil industry carries the greatest burden of taxation of any industry in the United States. Oil prices, he said, have risen less since 1913 than any other domestic product. Although the oil men have fully co-operated with the Federal Conservation program, Mr. Franklin asserted that imports have increased in direct ratio with curtailment. Inasmuch as imports could not be restrained without violating the Sherman Anti-Trust laws, he advocated a tariff as the only solution.

Unknown Element Located In Lepidolite

THE unknown element, No. 87, has been located in lepidolite, a form of mica, and pollucite, a mineral consisting chiefly of the elements caesium, aluminum, and silicon, according to experiments made by Dr. Fred Allison and Edgar J. Murphy, both of the physics department of Alabama Polytechnic Institute. Studies showed the effects that should be caused by element No. 87, and this, say the experimenters, "affords evidence of considerable weight for its presence in the sample under test."

Dow Chemical Gets Patent On Diphenyl Oxide

A United States patent has been granted, under date of Jan. 26, to the Dow Chemical Company, of Midland, Mich., covering a new process for the manufacture of diphenyl oxide. The method includes reacting at high temperature a halogenated benzene with an alkaline agent in aqueous medium and in the presence of copper.

Federal Policy on Alcohol Control Explained

THE federal government's policy and problem relating to industrial alcohol is fully described in a monograph authorized by J. M. Doran, Commissioner of Prohibition, for distribution to federal official personnel co-ordinated in enforcement, and through other official channels.

The government's system of control to assure an ample supply of alcohol for legitimate industry, and to prevent unlawful uses, is described. Measures to restrict the use of alcohol to legitimate industry, to prevent diversions to illicit channels, the policy of strengthening denaturants, improving formulas, rigid inspections of operations of government permit holders, establishment of alcohol production quotas limiting output to actual commercial requirements, vigilant inspection procedure maintained to eliminate dishonest permittees, and other essential factors in the problem, are fully explained.

In referring to the widespread use of industrial alcohol, the monograph points out that motorists are using more than 35,000,000 gal. of completely denatured alcohol each year in anti-freeze solution for automobile radiators. Nearly 9,000,000 gal. of specially denatured alcohol is used annually in the manufacture of lacquers. More than 1,000,000 gal. is used in the manufacture of imitation leathers.

A single artificial silk manufacturing concern uses 3,000,000 gal. of specially denatured alcohol. In the manufacture of bathing alcohol more than 1,000,000 gal. is required. More than 5,000,000 gal. is used in the manufacture of shellacs, varnishes, and paints. In the manufacture of vinegar more than 9,000,000 gal. is used. Toilet water preparations, perfumes, and cosmetics require about 2,000,000 gal. each year.

Ethyl alcohol is necessary in the manufacturing of a wide range of foods and medicinal products, and the demand is growing in volume with the normal expansion of business and the growth of population.

American Cyanamid Buys Dye Companies

THE American Cyanamid Company has acquired through an exchange of stock the business of the Passaic Color Company, Passaic, N. J., and that of the Garfield Aniline Works, Garfield, N. J. These companies will be consolidated with that of the Calco Chemical Company, which was acquired by the American Cyanamid Company several months ago.

The Kalbfleisch Corporation, which is connected with the American Cyanamid Company, has purchased the sulphate of alumina plant of the Jarecki Chemical Company, Cincinnati. Kalbfleisch also has acquired the Superior Chemical Company, producer of alum at Joliet, Ill.

NEWS FROM WASHINGTON

By Paul Wootton

Washington Correspondent of Chem. & Met.

A SHARP slashing of chemical tariff rates began in the Senate as soon as the tariff bill was thrown open to individual amendments. With the coalition sentiment toward low duties holding a small but controlling majority, many an item was not only shorn of the added protection granted by the House and Senate committees but even placed below the level of existing law. Some chemical commodities withstood the attack, but most of the amendments proposed by the Progressive group were accepted. Among the items hit were synthetic camphor, red lead, acetic anhydride, baking soda, borax, soda ash, formaldehyde, and casein glue. The rate reductions should not have a large effect on the industry as a whole, as most of the changes apply to products of relatively small import volume or, conversely, to those not largely produced in this country. American valuation on dyestuffs was retained by a decisive vote.

In fact, beyond the changes tabulated in this issue, any far-reaching upsets in items of chemical interest would be surprising aside from some few adjustments when the bill goes to conference. As to the ultimate passage of a new tariff act, the doubters are growing fewer. One way of looking at it is that after Congress has spent more than a year in preparing the thing, neither party would want to place itself in the ridiculous position of saying that all was in vain.

AN element of uncertainty entered the debate through Feb. 7 to 10 when it was proposed to cut the rate on spirit varnishes containing 5 per cent or more of methyl alcohol, Par. 77 of the Senate Bill, from 25 to 20 per cent ad valorem. This involved a basic question inasmuch as the varnish industry had not been given an opportunity to present its case on this item, the tariff status of which had not before been mentioned. Though some of the recent changes place chemical products not only below the Finance Committee rates but below the level of the existing law, each case heretofore had come up in the committee hearings. After an extended discussion of the justice of such a departure from past practice, the motion was defeated. Probably the principal cause was that the Senate has enough on its hands without extending the scope of the tariff tourney.

A farm bloc attempt to assess all starches at 2½c. per pound was speedily defeated on Feb. 10, thus removing another controverted item from the picture. This proposal would have put all food and textile starches, including tapioca, sago, cassava, and rice starch, at the potato starch rate, on the grounds

that these import commodities compete with American farm products.

A bill greatly extending the scope of the oleomargarine act was passed by the House on Feb. 6 and has been referred to the Senate Committee on Agriculture and Forestry. The purpose is to include under the present tax of ¼c. per pound for uncolored products and 10c. per pound for colored products a variety of substitute products, especially those made from imported nut oils. At first glance, the wording would seem to apply to items far afield from butter, such as pharmaceutical preparations, illuminating oils, liquid emulsions, liquid preservatives, oil meals, cleansing compounds, and flavoring compounds, but the proponents of the bill have filed a statement asserting that these will not be touched by the pending legislation. Senator McNary, chairman of the Committee on Agriculture, has announced that views in opposition of the bill will be subject to a hearing about Feb. 14.

SINCE chemicals, oils, and fats make up Schedule 1 of the Tariff Bill, the chemical items were the first to feel the force of the Senate reaction. The fight began on Feb. 5. At that time the bill was thrown open to amendments from the floor with the fixed plan of running through the commodity schedules by number, following which additional amendments may be offered at will. Previously, the Senate had spent long months in skipping about at random through the bill as changed by the Finance Committee.

With their fighting spirit undampened by the decisive retention of American valuation for dyestuffs the day before, the Progressive element, reinforced by low-tariff Democrats, attacked item after item on the chemical list. Senators LaFollette, Harrison, and Barkley were foremost in shaping the close decisions

which followed. Many a rate tumbled by a vote of 41 to 39, or 37 to 35; others were saved by an equally narrow margin.

Synthetic or refined camphor was a subject of extended debate before the existing rate of 6c. per pound was cut to 5c. by a strong majority. Passing through a series of vicissitudes, camphor was reduced to 1c. per pound by the House Committee on Ways and Means and restored to 6c. by the Senate Finance Committee. The 1c. rate, the same as that on crude natural camphor, was again proposed, but Senator Harrison did not concur, arguing support of the turpentine market and thus of the Southern naval stores industry. This statement was questioned, and the point was made that the American chemical industry has failed to supply a significant part of the nation's needs in camphor. Thus the 5c. compromise finally was accepted.

THE paint paragraph was a center of controversy from the viewpoint that the farmer needs cheap pigments with which to decorate his barns and outhouses. Litharge and red lead took slight reductions but white lead survived a long argument and still stands at 2½c. per pound. A rate of 2c. was proposed. On lead pigments not specially provided for, a reduction from 30 per cent to 25 per cent was advocated, but not passed. The roll calls showed almost a tie on both these items. Senator Harrison stated that he would ask a separate vote on both when the bill comes up for final confirmation, at which time a reversal is not improbable.

Most of the other reductions were on the grounds that imports of the item in question are negligible or that the domestic industry is in a prosperous condition and can bear a general lowering of the tariff wall. The Progressives came armed with an imposing array of statistics which were difficult to upset on such short notice. The detailed changes since Feb. 5 are noted in the accompanying table.

Tariff changes in chemical schedule made by Senate floor amendments starting Feb. 5, rates are in cents per pound unless otherwise stated.

Paragraph	Item	Rates		
		Existing	Finance Committee	Proposed
1	Acetic anhydride.....	5	5	2½
	Formic acid.....	25%	4	25%
	Boric acid.....	1½	1½	1
	Phosphoric acid: less than 80 per cent.....	2	2	2
	80 per cent or more.....	2	3½	2
3	Acetone and ethyl methyl ketone, their homologues, and acetone oil.....	25%	25%	20%
6	Aluminum sulphate, alum cake, etc., containing not more than 15 per cent of alumina and more iron than the equivalent of one-tenth of one per cent of ferric oxide....	0.3	0.3	0.2
11	Synthetic gums and resins.....	20%-25%	4 plus 30%	20%-25%
20	Chalk; dry, ground, or bolted.....	25%	0.4	25%
30	Collodion, etc.....	35	35	30
41	Formaldehyde solution or formalin.....	2	2	1½
42	Gelatin and glue, n.s.p.f.; value less than 40.....	20% plus 1½	25% plus 2	20% plus 1½
	Value 40 or more.....	20% plus 7	25% plus 7	20% plus 7
	Casein glue.....	25%	25%	30%
50	Magnesium oxide or calcined magnesium.....	3½	7	5
52	Camphor, refined or synthetic.....	6	6	5
	Menthol.....	50	50	30
82	Sodium bicarbonate or baking soda.....			Free
	Borate or borax, refined.....			Free
	Thiosulphate.....			Free
	Carbonated, calcined or soda ash, hydrated or sal soda, and monohydrated.....			Free
72	Carbon black.....	20%	20%	15%
73	Litharge.....	2½	2½	2½
	Red lead.....	2½	2½	2½

Patent Litigation Interests British Chemical Industry

Test Case Initiated to Determine Life of Protection Period

From Our London Correspondent

THE TECHNICAL press has been reviewing the past year and the chemical industry appears to be one of the few bright spots both as regards home trade and export. This appears to augur well for the coming year, particularly as the heavy industries are taking slow and somewhat painful steps toward putting their house in order, in spite of the depressing effect of possible government interference and the inevitable effect of the Coal Bill, whether passed in its present form or not. The chief burden on industry undoubtedly is taxation, both general and local, and it remains to be seen whether the Disarmament Conference will produce anything tangible to counterbalance the increased expenditure which threatens the taxpayer.

For the chemical industry the past decade undoubtedly was one of transition and readjustment and it has probably been more successful in maintaining the relative position of this country in world trade than any other. This may partly be due to the fact that the chemical industry has necessarily had to face more rapid obsolescence than others and has been quicker to grasp the principles of co-operation with the existing financial system, and the value of international understandings as regards prices and processes.

PROBABLY the outstanding event of the year was the entry of Imperial Chemical Industries into the synthetic fertilizer market on an international scale. The immediate result of such a large increase in the world's nitrogen production was a reduction in, and a partial stabilization of, prices through an understanding with the I.G. and Chile. Since then other German producers have to a great extent fallen into line, and while the present tendency is still for production to overtake consumption, those competent to judge are definitely of opinion that the pendulum will swing the other way before the end of next year. The I.C.I.'s factory at Billingham has been organized to meet the demand for phosphate fertilizers as well as for nitro chalk and ammonium sulphate; the experimental station at Jealott's Hill and extensive propaganda are all part of a carefully thought out scheme designed to make remunerative an undertaking which will have cost the best part of \$120,000,000, and which is likely to be the beginning of far-reaching developments in other fields.

The future of the dyestuffs industry is to some extent tied up with the future fiscal policy of this country, but now rests on a more solid foundation than would have been possible during its

independent existence. In this connection reference may be made to the litigation which is now proceeding between Imperial Chemical Industries and the German I.G. in regard to what are known as selection patents, a test action having been initiated in regard to azo dyestuffs. This litigation is of definite interest and importance to the chemical industry as a whole, seeking as it does to obtain guidance for the future in regard to what is permissible and what is not in patent applications of a chemical nature. The burden of Imperial Chemical's complaints is that it should not be feasible for a patentee to protect a field broadly for a period of years and then by further digging in this field to select certain crops and seedlings which have not yet sprouted and use these as the basis for patent protection for a further period of years.

THIS dyestuffs patent action has already occupied the attention of the court for several weeks and the published reports are full of interest. Dr. Otto Oberlander and Dr. J. N. Goldsmith have presented the case for the defendants, the I.G. with great ability and the utmost fairness, but it seems inevitable that something will be done to limit not only the extent to which selection patents are in future permissible but also the scope of the patents which are the subject of the present action. Imperial Chemical Industries therefore has to some extent done a public service in taking action while the I.G. is likely also to be vindicated to a very large extent inasmuch as much of the hostile criticism to which its patent activities have been subjected in the past will be justified and appreciated in true perspective. The case has just concluded and judgment is reserved and will not be delivered for some weeks; it will be interesting to see whether the heavy expense of taking the case to a higher tribunal will be considered worth while, whatever the result.

Lord Melchett, who has just gone to South Africa, is to be the president of the Society of Chemical Industry for 1931-32, which is the jubilee year of the Society of Chemical Industry. Dr. Levinstein's term of office indicates steady progress and efficiency and the new general secretary, H. J. Pooley, is an undoubted success. Lord Brotherton has been chosen as the Messel Medal lecturer for 1930. This is an admirable selection, Lord Brotherton having been a member of the society since its foundation nearly 50 years ago and is one of its most popular and distinguished vice-presidents.

Considerable interest has been aroused

by the publication under the auspices of the Ministry of Transport of an experts' report upon the treatment of sulphur fumes in connection with the working of the proposed electric power station of the London Power Company. As this is situated not far from the Houses of Parliament and on the river, fears were expressed both in regard to the dust nuisance and to the possibility of corrosion and other inconvenient results due to the presence of sulphur compounds in the atmosphere. Experiments were carried out for the removal of sulphur dioxide by washing both with hot and cold water, and the results were sufficiently encouraging to enable the experts to draw up a scheme for the treatment of the gases from this power station, by which it is hoped to remove between 80 per cent and 90 per cent of the sulphur and substantially all the dust. The quantity of water required per ton of coal burned varied between 10 tons and 20 tons, and it was found that with a low sulphur coal as little as 6 tons of water per ton of coal burned would effect a removal of 90 per cent of the sulphur gases.

ONE does not hear much about progress in low-temperature carbonization just now, but a lot of work is being done in a quiet way. This is perhaps admirably summarized in a booklet which has just been published by Salerno, Ltd., in regard to its particular type of plant, which is being tried out by the Gas, Light & Coke Company. The booklet is admirably produced, and in particular includes an excellent summary of the outlet for primary tar and of the work which has been proceeding in numerous directions for its commercial utilization and valuation. It is common knowledge that uncertainty in regard to the value of low temperature tars is one of the factors which has impeded the installation of low temperature plants.

Reference was made in these columns recently to the Imperial Smelting Company which took over the National Smelting Company, of Avonmouth. This has now been followed by the formation of the Amalgamated Metal Corporation, Ltd., which in addition to acquiring the shares of the British Metal Corporation, Ltd., and of Henry Gardner & Co., Ltd., is obviously to be closely associated with Imperial Smelting Corporation. The board of directors also includes Sir Auckland Geddes, chairman of the Rio Tinto Company; R. C. Stanley, president of the International Nickel Company of Canada, and J. J. Warren, president of the Consolidated Mining & Smelting Company of Canada, Ltd. The activities in the nitrogen field of the last named have also been referred to recently, and this new company with a capital of \$25,000,000 and so closely connected through Henry Gardner & Company and through the Consolidated Mining Corporation, with the Imperial Smelting Corporation, is bound to play an important part in pending chemical and metallurgical developments.

France May Increase Production of Industrial Alcohol

Distillation of Rye Proposed to Absorb Surplus Stocks

From Our Paris Correspondent

THE splendid 1929 harvest, partly due to the increased use of fertilizers, has had unfavorable repercussions on the grain market. The sales of rye particularly have been exceedingly slack, as nowadays the use of rye in bread-making flours is no longer compulsory. It is now contemplated to distill rye for the production of industrial alcohol. The distillation of grains is by no means a new industry in France and was flourishing before the World War, but at present the state has the sole right to establish the selling price of alcohol, and this price has become so low that the manufacture of industrial alcohol ceases to be a paying proposition. This state interference had its reasons during the war, when cereals were scarce in war devastated countries and had to be imported at heavy expense, but nowadays this official interference has no object. In fact, these rules and regulations apply not only to the distillation of alcohol from rye and wheat but also from rice, rice-folds, maize manihoc, millet, sorgho, etc. In pre-war days about twenty distilleries produced large quantities of grain alcohol and some of them treated nearly 2,000,000 cwt. of fermented grains unsuitable for foods. The process used is French, being the result of the collaboration of French bacteriologists and chemical engineers. Among the former, Mr. Calmette should be especially mentioned as being the bacteriologist who succeeded in the isolation of mucors employed in the Far East for the manufacture of "saké" or rice-wine, the mucor amylomyces or amylomyces Rouxli. Mr. Boidin was the chemical engineer who applied this new process industrially.

This process is used on a large scale in Indo-China by the Société des Distilleries d'Indo-Chine with exceedingly good results, 42 to 47 liters of alcohol being obtained from 100 kilograms of rice, while maize and sorgho yield only from 36 to 43 liters.

THE SITUATION of French metallurgy has greatly altered since the return of Lorraine and the incorporation of the Sarre territory within the French custom area. The pre-war output has actually doubled, reaching 9,981,000 tons of cast iron and 9,950,000 tons of steel in 1928. As half of this output is absorbed by the home market, this clearly indicates that mechanical and machinery industries are growing steadily; nevertheless the consumption of siderurgical products is far less developed in France than it is in the United States, as may be seen

by the following figures: 170 kilograms per inhabitant per annum in France against 480 kilograms per inhabitant per annum in America.

France exports, however, from four to five million tons of metallurgical products worth three billion French francs. French exports are imported in Great Britain, Belgium, and Germany under the form of iron bars, blooms or billets. French imports are not important, as they reached only 125,000 tons in 1928, of a total value of 265 fr. To gain new markets the French metallurgical trade should not only manufacture better products (as regards quality France already competes favorably with her foreign competitors) but French cost prices should be cut down. Several devices have been applied to that effect, modern electrical and mechanical appliances being experimented with in order to increase the output and reduce the labor.

It is also hoped transport tariffs will be lowered, but it is feared that all these favorable measures will be counterbalanced by the application of the state social insurances coming into force in France in February, 1930.

PREVIOUS reference has been made to the work done by the Statistics and Economical Branch of the International Labor Office of the League of Nations in order to unify the custom classification. In its third meeting held in the month of January, 1930, this office classified vegetable and animal fats and oils, chemical and pharmaceutical products, tanning and tinctorial extracts, colors, pigments and varnishes, aromatic oils and essential oils, soaps, candles, gums, explosives and fertilizers. In the next meeting the office will classify leathers, skins and furs, paper and similar products, mineral compounds, including mineral oils and their products. These classifications will be carefully revised, the experts' work being then shown to all competent industrial and commercial circles, whose observations will be taken into consideration.

Competent circles should insist upon a clearer classification and clear custom statistics. In 1930 official statistics stop at 1927. A monthly custom list is published, but all figures quoted should be taken as temporary, the official list published with two years' delay being the only one to give definite revised figures. Other and similar documents may be found in the French Year Book of General Statistics. The last annual, published in 1928, gives all 1927 quotations; unfortunately the figures quoted

refer only to the big mining and metallurgical industries and a few important raw materials. It is difficult to obtain definite information concerning specialized industries even when official investigation is made. No better proof can be given than the information gathered in the official inquiry made during the war in all branches of French industries, a complete report of which appeared in 1919 under the name of General Report on French Industry, Its Present and Future (3 volumes). Even this work does not give entirely reliable information, as some of it was deliberately incomplete. As a rule French manufacturers show the greatest reluctance to give any information concerning the organization and output of their works, as they do not wish their competitors to learn from them.

Kuhlmann Reports Success Of Ammonia Plants

A REPORT from Paris to the Department of Commerce states that the German press reported that the co-operation between the Kuhlmann company and the big French coal companies—the Marles, Courrières and Anzin companies—for the production of synthetic ammonia from coke-oven gas had not yielded the results expected, and that the Kuhlmann company had decided to equip independent installations.

The Kuhlmann company has denied the allegation and further stated that the co-operation between the companies resulted in the erection of very large plants, which are in the course of full development. The ammonia production of the Marles-Kuhlmann plant has been doubled, while that of Anzin-Kuhlmann will be doubled in the course of a few weeks, and the Courrières-Kuhlmann methanol plant has been working satisfactorily for the last five months. A plant for the production of ammonia and an apparatus for the production of sulphuric acid are now under construction. New projects are now being studied by the interested companies, and the close connection between the chemical and coal industries may lead to further developments.

The Selzaete factory commenced the production of ammonia in October, 1928; the Madeleine plant, now fully equipped, began production during December, 1929.

Glass Joint Standard

At a meeting held in Washington on Dec. 17, 1929, under the auspices of the U. S. Bureau of Standards, manufacturers, distributors, and users of interchangeable ground glass joints for industrial and laboratory glassware met to adopt a standard. Standard taper, length, diameter, and markings for joints were chosen. The Bureau is now soliciting approval of all interested parties.

Carbon Dioxide Fertilization Opens New Market for Coke

Numerous Processes Developed by German Engineers

From Our Berlin Correspondent

A NEW possible market for coke, especially during the off-season in summer, is promised by carbon-dioxide fertilization. Numerous processes already exist, and the process of Riedel, Essen, using the combustion gas for inundating large areas, has already been set up in various small farms and vineyards and subsequently on areas of several hundred acres. This method, employing a coke low in sulphur and smoke, can be applied to a steam boiler, which utilizes the waste heat for other purposes. In the two scrubbing towers the gases are cooled by thorough showering with water and passed over limestone to remove impurities, such as acid, tar, and dust, that are noxious to plants. Distribution of the gas is effected by a ventilator, which sucks in the combustion gases and propels them on to the field. A locomotive drives the ventilator, and its exhaust gases are combined with the other as fertilizer. The gas mains are of cement and lie in the fields below ploughing depth, with connections protruding about two feet. According to the weather, the various fruits are gassed in the morning and afternoon for a few hours, and the effects are noticeable in quality as well as quantity. It is important, of course, that the wind be taken into consideration and that hedges or ridges provide shelter. Since CO_2 fertilization steps up the organic living process, it is necessary also to count on an increased nitrogen consumption.

NITROGEN production is making gains in Germany in spite of the danger of a flooded market. In the Silesian coal district, the Stickstoff A.-G., Waldenburg, is now beginning fertilizer production too (70 tons of ammonia daily). This plant makes its nitrogen-hydrogen mixture from coke-oven gas which is cracked; ammonia is made by the Nitrogen Engineering Corporation's (New York) process.

At the Berlin V-D-I meeting, Professor Rassow spoke on the present state of coal liquefaction. The continuous process seems to be unsuccessful as yet and to have been displaced by a two-step method of hydration. In the first step the coal is partly hydrated to oil, and in the second these products are split and further hydrated. The present production is about 300 tons daily—i.e., 100,000 tons a year—and hence represents only a fraction of Germany's need for 800,000 tons. It is expected that the output will certainly be increased very soon.

Coking or distillation of coal under pressure has been developed by Franz Fischer and his associates to a semi-plant scale. The results vary, depending on the coal, from a firm semi-coke to a

dense coke. In a commercial application of this process, which develops its own pressure without mechanical help, the following advantages are obtained: a firm coke or semi-coke from even a powdery lignite; gas under a pressure which will condense its benzene content on cooling, will facilitate scrubbing, and allow it to be cooled to liquid by expansion or shipped afar by pipes. The latter possibility is favorable, because the gas scrubbed of CO_2 has a heat value up to 9,000 cal. per cubic meter.

SYNTHESIS of sugar and alcohol from wood is a problem that occupies much thought here and has possible significance for agriculture, which is in dire straits at present. Of the two main processes, that of Bergius treats wood (chips, shavings) with concentrated hydrochloric acid, and the cellulose is converted, up to 60 per cent, into a water-soluble carbohydrate, which may be called a wood-sugar. The acid is expelled with hot gas-oil, which is then centrifugally separated from the sirup and returned to use. Attempts to use this product as a hog-feed have been very successful and there are hopes of reducing corn and oat importations by its development as fodder. The lignin substances in the wood are unattacked by the process, can be filtered from the sirup, and be used effectively as fuel briquet.

A second process has been developed by Scholler at the Tornesch Company in Holstein; its primary objective, however, is alcohol rather than sugar. At 15 atm. and 170 deg. C., one part of wood is treated with nine parts of very weak sulphuric acid. Because the resultant weak sugar solution would yield a very expensive sugar, it is instead fermented with yeast, yielding about one part of absolute alcohol for each four parts of dry wood. The price of this alcohol is so low that it can be used profitably as an engine fuel mixed with gasoline.

In spite of long efforts, little success had hitherto attended attempts to simulate animal fibers by introducing nitrogen in rayon. New hopes are aroused by two new patents of Professor Bergmann, Dresden (G.P. 442,520 and 445,503). The first one is based on the finding that collagen (the glue substance in bones, skin, etc.) is easily soluble in ammoniacal copper or nickel oxide, in spite of its resistance to acids and alkalis. In this way it gives an 8-per cent solution in less than an hour, from which it can be precipitated with various reagents. Bergmann gives important examples and speaks of the possibility of dissolving cellulose together

with collagen in metal-ammines, thus producing rayon with special properties. It also is of interest that tanned leather scrap and the like also can be treated in this way in very few hours.

The second patent relates to keratins, which, besides being difficultly soluble, break down readily in alkali. They, too, are readily soluble in metal-ammines and can again be easily precipitated, so that they also offer themselves as a component of rayon. The work of Bergmann was mainly devoted to determining the principles, and not to commercial ends, but according to the rayon authority, Dr. Stadlinger, the prospects are very favorable.

The Eisenschwamm, G.m.b.H. (Sponge Iron Company), founded by Krupps and Vereinigte Stahlwerke, will begin production at the rate of 15,000 tons at the end of February. The economic significance of sponge iron, which is produced by low-temperature reduction from the ore, lies at present in its use as an addition to steel.



Chemical Engineers Enroll At Cooper Union

ONE hundred and fifty graduate engineers employed in the chemical industries have enrolled in the evening course in physical chemistry inaugurated by the Cooper Union Institute of Technology as a practical experiment in "education for the educated," according to an announcement by Dr. Albert B. Newman, director of the chemical engineering department.

The members of the class hold degrees from 65 different institutions of college rank in the United States, England, Canada, Norway, Sweden, Germany, Austria, and South Africa. All but two have bachelor's degrees. Fifteen have master's degrees, and four the doctor's degree.

Practically without exception, Professor Newman said, the men have been successful in their fields, managers and directors of industrial laboratories, department heads, and research executives being well represented in the enrollment.

The students are engaged in diversified industries. Chemical manufacturing, petroleum refining, electrical and electro-chemical industries, metallurgy, the textile trade, and food products are among the general groups which have substantial representation.

A course like this would be valuable in other fields of engineering, although it is peculiarly necessary in chemical engineering because of the recent advances in the theory of physical chemistry, thermodynamics and allied subjects.

Professor Newman announced that next fall his department is planning to follow the first year course, which will be completed in March, with a new evening course in the unit operations of chemical engineering, embracing a study of the underlying theory of the flow of fluids, heat transmission, fractional distillation, drying, evaporation, extraction and absorption.

MEN

in Chemical Engineering

JULES BEBIE has just terminated a strenuous technical career in presenting his resignation as chemical director of Monsanto Chemical Works, St. Louis. In his eightieth year, Dr. Bebie foresees no professional plans except a development of the science of enjoyable living.

IRVING LANGMUIR, closely identified with research in the General Electric Company and president of the American Chemical Society in 1929, will receive the Willard Gibbs Medal at the Chicago section of the Society on May 24. The award was made for Dr. Langmuir's contributions in nearly all branches of physical chemistry, his atomic researches, and his presentation of a theory of atomic structure.

PAUL J. KRUESI, president of the Southern Ferro-Alloy Company, and F. A. LIDBURY, president of the Oldbury Chemical Company, have been elected to the board of directors of the Swann Corporation, Birmingham, Ala.

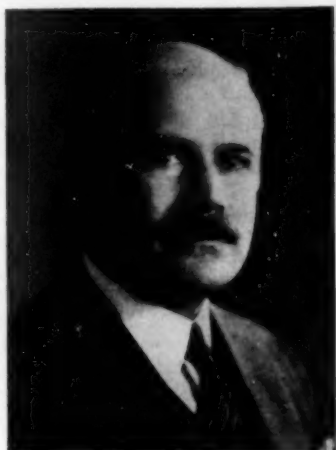
E. M. HONAN, formerly of the chemical department of the Bell Telephone Laboratories, is now in chemical research for the Electrical Research Products, Inc., Los Angeles, Calif.

LEE T. SMITH, who was engaged in chemical research for the Goodyear Rubber Company, is now in the chemical department of the Bell Telephone Laboratories, New York.

SAMUEL EDWARD SHEPARD has been selected to receive the William H. Nichols Medal for 1930 on March 14 in New York. Dr. Shepard, who is assistant director of research for the Eastman Kodak Company, Rochester, N. Y., has been chosen for outstanding achievement in the chemistry of photography.

W. K. MCINTOSH, formerly president of the Liquid Carbonic Corporation, has been succeeded by W. A. Brown and was made chairman of the board.

FREDERIC J. LEMAISTRE, with an extensive experience as chemical engineer and consultant, has been appointed executive secretary of the American Institute of Chemical Engineers. He will be situated at the official headquarters in the Bellevue-Court Building in Philadelphia, the city where the Institute was founded in 1908.



A Canadian by birth, Mr. LeMaistre has been identified with American chemical industry ever since his graduation from McGill University, in 1904. After two years with the American Cement Company, he joined the du Pont Company and remained with it for 14 years, receiving broad chemical engineering experience in the manufacture of explosives, solvents, pyroxylin, and artificial silk. In 1916 he was given leave of absence, by the du Pont Company, to go to France as a member of the American Industrial Commission, which the French Chamber of Commerce had invited to study the technical problems involved in the reconstruction of the devastated area. Returning to du Pont, Mr. LeMaistre received the position as head of the chemical department in charge of solvents, which he occupied until he opened his consulting office in Philadelphia in 1920.

Mr. LeMaistre has been a member of the American Institute of Chemical Engineers since 1910, and numerous other clubs and societies count him among their number. His appointment followed an almost unanimous vote by the membership of the Institute in favor of employing a paid executive secretary to manage the business affairs of the organization. H. C. Parmelee, editorial director of the McGraw-Hill Publishing Company, who was recently elected secretary, continues in that office, although relieved by Mr. LeMaistre of carrying the entire burden of the Institute activities.

JAMES F. WALSH, head of chemistry and research for the Celluloid Corporation, Newark, N. J., has been elected vice-president of the company as its technical director.

WILLIAM MCPHERSON, dean of the graduate school of Ohio State University, has become president of the American Chemical Society for 1930. He succeeds Irving Langmuir and will be followed in 1931 by Moses Gomberg, professor of chemistry at the University of Michigan, who was chosen president-elect. Professor McPherson was acting president of his university in 1924.

F. M. DE BEERS, chemical engineer and former executive of the Swenson Evaporator Company and later of the Sunmaid Raisin Company, has joined the J. P. Devine Manufacturing Company as general sales manager with offices in Chicago.

STEVEN SCHWARTZ, formerly of the Graver Corporation, has become manager of the petroleum division of the J. P. Devine Manufacturing Company, Mount Vernon, Ind.

NELSON LITTELL, surviving member of the patent law firm of Hammond & Kittell, has contracted a new partnership to continue consultancy under the original firm name.

JOHN D. GILLIS, assistant to the president of Monsanto Chemical Works at St. Louis, has been appointed executive of the Graesser-Monsanto Chemical Works, Ltd., London, for where he sailed from New York on the "Olympic" on Jan. 11.

R. V. MCGREW has transferred from his research work with the Röhm & Haas Company, Philadelphia, to the Pennsylvania State College School of Chemistry.

OSCAR T. QUIMBY, since 1928 on the staff of the U. S. Forest Products Laboratory, has left to join the research division of the Procter & Gamble Company at Cincinnati, Ohio.

HARRY C. BUTCHER, chief assistant to the secretary of the National Fertilizer Association, has resigned to become Washington representative of the Columbia Broadcasting System, where he will retain his connection with fertilizer and agricultural interests.

RAY M. HUDSON, assistant director of the National Bureau of Standards since 1923, has resigned to become secretary of the New England Council's Massachusetts Division.

RUDOLPH SPRECKELS, president of the Spreckels Sugar Company, Yonkers, N. Y., has been elected president of the Sugar Institute, Inc., New York, to succeed Earl D. Babst, who declined reelection and became honorary president.

CHARLES R. PARKS, formerly of the Massachusetts Institute of Technology and the Goodyear Tire & Rubber Company, has joined the staff of the United Carbon Company, Charleston, W. Va.

CALENDAR

AMERICAN CERAMIC SOCIETY annual convention, Toronto, Feb. 16-21.

AMERICAN CHEMICAL SOCIETY, 79th meeting, Atlanta, Ga., April 7 to 11.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, St. Louis, May 29-31.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Detroit, June 4-6.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York, Feb. 18-20.

A. E. MARSHALL, consulting chemical engineer of New York, returned from a five-week visit to England on Jan. 16. Although not bent on professional duty while there, the Council of the British Institute of Chemical Engineers tendered him a dinner and used the occasion to express again its pleasure at the reception given to British engineers in the United States and Canada in 1928.

GEORGE M. VERITY, president of the American Rolling Mill Company, Middletown, Ohio, since its inception in 1899, has been elected to the position of chairman of the board and is succeeded by Charles R. Hook, who also remains general manager.

WILLIAM E. LEVIS has been elected president, general manager, and chairman of the executive committee of the Owens-Illinois Glass Company, succeeding William H. Boshart, who was forced to resign by ill health. Mr. Levis is a graduate of the University of Illinois and was president of the Illinois Glass Company until it became merged with the Owens concern in 1929.

JOHN A. CHEW has joined the Swann Corporation of Birmingham, Ala., as vice-president of the Federal Phosphorus Company. Mr. Chew, who will have his headquarters in New York, was vice-president of the Warner Chemical Company and Westvaco Chlorine Products, Inc., for 13 years.

OBITUARY

CHARLES A. TRIPP, explosives expert long associated with the DuPont company, died on Feb. 11 at Wilmington, Del., at the age of 59. Mr. Tripp was a graduate chemical engineer from Massachusetts Institute of Technology and was located at Indianapolis until 1917, when he joined Ernest DuPont in successive powder company developments.

ROBERT OXNARD, former president of the American Sugar Refining Company and the American Beet Sugar Company, died on Feb. 11 at his home in San Francisco. Mr. Oxnard was 76 years old and had spent his entire life in the sugar industry, starting in Louisiana. It was in 1890 that he and his brother brought beet sugar technology from Europe and implanted it in Western sections of this country.

JOHN I. TIERNEY, secretary of the Manufacturing Chemists' Association for the past ten years, died in Washington at the age of 54 on Dec. 23, following an operation several weeks before.

GEORGE G. RAMSDALL, pioneer in the American gas industry, died of pneumonia at his home in Brooklyn, N. Y., on Dec. 27. He was 81 years old, and in the course of his life had contributed, both technically and through his extensive association work, to the career of his industry.



Underwood & Underwood

HERBERT H. DOW

HERBERT H. DOW was the recipient of the Perkin Medal at a dinner in the Chemists Club, New York, on the evening of Jan. 12. In receiving the award, which was made for his "valuable work in applied chemistry," Dr. Dow read a highly interesting paper on "Economic Trends in the Chemical Industry." His life and accomplishments were described by James T. Pardee and E. O. Barstow, both of Dr. Dow's company, who combined to give the ceremony a worthy technical setting.

A. S. Fox, who was research director of the Grasselli Powder Company, has resigned to fill a similar post for Burton Explosives, Inc., at Cleveland.

MATTHIAS WELLES PARSONS, founder and active head of the firm bearing his name, died in his 80th year in New York on Jan. 11. His firm, the leading producer of zinc stearate and an extensive importer, was founded by him in 1908 and remained under his active guidance until his death.

S. T. MATHER, whose most recent post was as director of the National Park Service, which he founded, died on Jan. 22 at the age of 63, of a stroke while undergoing treatment in Boston. Although Mr. Mather's outstanding achievements were in connection with the national parks, he was long connected with the Pacific Coast Borax Company and later became president of the Sterling Borax Company and the Brighton Chemical Company.

PHILIP C. HOFFMANN, vice-president of the Virginia Carolina Chemical Corporation, died at Richmond, Va., at 64, on Dec. 18, after 25 years as director of production.

STUART WYETH, president of John Wyeth & Bros., Inc., Philadelphia, manufacturing chemists, died on Dec. 30 at the age of 65.

FRANCIS M. TURNER, Sr., expert on oils and fats and retired vice-president of Oil Processes, Inc., Harrison, N. J., died on Jan. 27. He was the father of Francis M. Turner, Jr., president of the Chemical Catalog Company.

INDUSTRIAL NOTES

WALKER VEHICLE COMPANY, Chicago has absorbed the Cravens Company for the expansion of its materials handling products.

DINGS MAGNETIC SEPARATOR COMPANY, Milwaukee, Wis., has appointed G. A. Reinhard Cleveland representative at 1836 Euclid Avenue.

MCGANN MANUFACTURING COMPANY, York, Pa., has added H. W. Munday to its staff at 228 North La Salle St., Chicago, as vice-president and sales engineer.

SARGENT C. LUNDY, INC., has removed its offices to 20 North Wacker Drive, Chicago.

HERCULES POWDER COMPANY, Wilmington, Del., has concentrated its Southeastern headquarters at American Traders National Bank Building, Birmingham, Ala., where J. J. Grimes is in charge.

LEWIS-SHEPARD COMPANY, Boston, has appointed H. A. Stevenson representative at 7310 Woodward St., Detroit, for eastern Michigan.

HOLLY PNEUMATIC SYSTEMS, INC., New York, is now represented by R. S. McReadie at 1532 Foucher St., New Orleans.

SCHAFER POCOMETER COMPANY, Pittsburgh is represented in the Chicago territory by H. W. Munday, of 228 N. La Salle Street.

INDUSTRIAL TRUCK ASSOCIATION, New York, has added William C. Babbitt to its staff as field engineer.

WORTHINGTON PUMP & MACHINERY CORPORATION has formed the Worthington Machinery Corporation of California, Ltd., at San Francisco and Los Angeles, with H. D. Cornell as president.

FALK CORPORATION, of Milwaukee, is being represented in Buffalo, N. Y., by Root, Neal & Company, and in Youngstown, Ohio, by Youngstown Steel Sales, Inc.

J. H. DAY COMPANY, Cincinnati, Ohio, has installed an experimental laboratory at 62 Murray St., New York, which will be available to all having problems of mixing, agitation, grinding, and the like.

GENERAL REFRACTORIES COMPANY, Philadelphia, has acquired the Evans & Howard Fire Brick Company, of St. Louis, Mo.

ALLIS-CHALMERS MANUFACTURING COMPANY has opened a sales office at Tennessee Electric Power Building, Chattanooga, Tenn.

COPPER HEWITT ELECTRIC COMPANY has received the new name General Electric Vapor Lamp Company, but its products continue to use the Cooper Hewitt designation.

AMERICAN ENGINEERING COMPANY, Philadelphia, is represented by W. H. Bixley, Inc., at 1004 Hubbell Building, Des Moines, Iowa.

COMBUSTION ENGINEERING CORPORATION has made James Cleary general sales manager at the main office, 200 Madison Ave., New York.

H. K. FERGUSON COMPANY has appointed Henry Maag manager of the Chicago office in the McGraw-Hill Building, 520 North Michigan Ave., Chicago.

EDWARD VALVE & MANUFACTURING COMPANY, East Chicago, Md., is now represented at 1121 Maple Ave., Bethlehem, Pa., by W. E. Groff.

MAGNETIC MANUFACTURING COMPANY is installing a new research laboratory on magnetic separation at Milwaukee, Wis.

HOCKWOLD CHEMICAL COMPANY, San Francisco, is moving into new quarters at 27 Bluxome St.

ROBERT E. KINKAD, arc welding specialist, has moved his Cleveland office to Builders Exchange Building, and opened a Chicago office at 330 North Western Ave.

YALE & TOWNE MFG. COMPANY, Stamford, Conn., has placed its materials handling sales in charge of J. C. Morgan and its hardware sales under W. B. Dodge.

ROLLER-SMITH COMPANY, New York, has appointed H. D. Stier representative for the Southeast at 101 Marietta St., Atlanta, Ga., and the H. N. Muller Company representative at First National Bank Building, Pittsburgh.

D. H. & F. M. ROOTS COMPANY and CONNERSVILLE BLOWER COMPANY, Connerville, Ind., the WILBRAHAM-GREEN BLOWER COMPANY, Pottstown, Pa., and the STACEY ENGINEERING COMPANY, Cleveland, Ohio, have merged their interests and will continue their present identities until any further steps are taken.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

Chickasha Cotton Oil Company reports for six months ended Dec. 31, 1929, net profit of \$448,121 after charges, depreciation and taxes, equal to \$1.76 a share on 255,000 shares of stock.

Stockholders of Merrimac Chemical Company, Inc., at annual meeting elected William I. Warren, treasurer, succeeding William M. Rand, who continues with the company as vice-president in charge of sales. Thomas Nelson Perkins was elected a director.

Procter & Gamble Company has extended the option to J. P. Morgan & Company, which permits the purchase of 90,000 shares of common stock at \$80 a share, to Aug. 2 from Feb. 12, according to Herbert G. French, vice-president of Procter & Gamble.

Pratt & Lambert, Inc., reports for the year 1929 a net profit of \$1,251,587 after charges and taxes, equivalent to \$6.18 a share on 202,500 no par shares, compared with \$1,432,924, or \$7.07 a share, in the preceding fiscal year.

Standard Oil Company of New Jersey is offering stock to its employees under its stock purchase plan at \$63 a share for the first six months of 1930. This price is based on the average price of the New York Stock Exchange for three months prior to the date of offering.

Report of Atlas Powder Company for the year ended Dec. 31, 1929, shows net income of \$2,542,692, equivalent after 6 per cent preferred dividends, to \$7.66 a share earned on 261,438 no-par shares of common stock. This compares with net income in 1928 of \$5,839,664, including profit of \$4,151,000 from sale of holdings in Canadian Industries, Ltd., equal to \$20.27 a share on common. Excluding profit after federal taxes from sale of Canadian Industries, Ltd., 1928 net profit is equal to \$6.30 a share on common.

J. T. Baker Chemical Company reports net sales for 1929 of \$2,610,187, compared with \$2,223,673 for 1928 and \$1,865,027 for 1927. Net earnings, after taxes and depreciation, amounted to \$235,790 for the year ended Dec. 31, equivalent to \$55 a share on the first preferred stock and after preferred dividends to \$1.80 a share on the common stock. For 1928 net earnings were \$197,894 and for 1927, \$148,948.

Report of Devoe & Reynolds Company, Inc., and subsidiaries for the year ended Nov. 30, 1929, shows net profit of \$1,085,615 after depreciation, interest, federal taxes, etc., equivalent after dividends on 7 per cent first and second preferred stocks, to \$5.16 a share on \$175,000 average number of combined Class A and Class B common shares. Based on 200,000 combined common shares at end of fiscal year, net profit is equal to \$4.52 a share. In the preceding year net profit was \$1,079,573.

Report of Air Reduction Company, Inc., for the year ended Dec. 31, 1929, shows net profit of \$5,972,995 after federal taxes, depreciation, etc., equivalent to \$7.75 a share on 770,402 no-par shares of stock. This compares with \$3,208,993 or \$4.60 a share on 696,793 shares in 1928.

Price Range 1929		Stock	Price Range in January			
High	Low		Jan. 2	High	Low	Jan. 31
225	77	Air Reduction.....	127	131	118	122
11	1	Ajax Rubber.....	1	2	1	2
345	197	Allied Chemical.....	257	280	255	280
23	4	Am. Ag. Chemical.....	7	7	7	7
69	20	American Cyanamid B.....	27	29	25	29
10	3	American Hide & Leather.....	4	4	4	4
81	31	American Metal.....	46	48	44	45
37	10	Am. Solvents & Chemical.....	12	12	10	10
45	15	Anglo-Chile-Nitrate.....	21	21	11	19
49	18	Archer-Daniels-Midland.....	25	27	24	25
18	5	Armour Ill. A.....	5	6	5	5
27	1	Assoc. Dyeing and Printing.....	2	2	2	2
140	67	Atlas Powder.....	89	90	81	89
32	12	Beacon Oil.....	15	16	14	15
101	45	Beechnut Packing.....	60	70	60	70
89	70	Bon Ami, A.....	70	72	70	70
34	25	California Petroleum.....	33	35	28	29
57	20	Celanese.....	13	13	11	13
32	10	Certainfeed.....	13	13	25	28
50	25	Chickasha Cotton Oil.....	52	53	52	52
90	40	Colgate-Palmolive-Peet.....	29	31	27	29
63	20	Commercial Solvents.....	89	95	87	94
126	70	Corn Products.....	89	95	87	94
69	21	Davison Chemical.....	30	34	28	33
64	24	Devoe & Reynolds.....	34	35	30	34
231	80	Du Pont.....	116	125	112	125
119	107	Du Pont 6pc. deb.....	117	117	115	115
264	150	Eastman Kodak.....	178	194	175	193
41	27	Firestone Tire.....	3	4	3	30
20	2	Fisk Rubber.....	3	4	3	4
54	23	Freeport Texas.....	39	44	38	42
64	26	Glidden Co.....	32	34	31	33
82	31	Gold Dust.....	38	45	37	45
105	38	Goodrich Co.....	41	46	40	46
130	80	Hercules Powder.....	55	59	52	57
109	23	Houston Oil.....	55	59	52	57
135	68	Industrial Rayon.....	117	124	112	115
17	4	Int. Ag. Chemical.....	4	7	4	6
26	9	International Paper Co.....	14	14	9	13
90	55	International Salt.....	77	77	69	72
45	20	Kellogg, Spencer & Sons.....	23	23	21	21
24	3	Kelly-Springfield.....	3	5	3	5
25	5	Lee Rubber & Tire.....	6	9	6	8
68	28	Lehn & Fink.....	20	34	29	33
43	17	Libby-Owens.....	20	26	19	26
113	40	Liquid Carbonic.....	56	61	52	60
72	29	Mathieson Alkali.....	38	43	37	41
80	47	Montanto Chemical.....	49	59	59	59
58	15	Nat'l Distillers Products.....	29	37	29	37
210	129	National Lead.....	137	171	137	168
87	60	New Jersey Zinc.....	66	75	66	75
79	64	Ohio Oil.....	71	71	69	70
98	43	Owens-Ill. Glass.....	55	55	52	55
47	24	Phillips Petroleum.....	35	35	31	34
76	49	Pittsburgh Plate Glass.....	53	58	53	58
85	49	Pratt & Lambert.....	57	57	55	57
98	43	Procter & Gamble.....	54	68	52	68
30	20	Pure Oil.....	23	24	22	23
105	75	Sherwin-Williams.....	18	26	18	25
48	14	Silic Gel.....	24	25	25	25
45	21	Sinclair Oil.....	32	32	29	31
46	28	Skelly Oil.....	60	61	59	60
81	51	Standard Oil, Cal.....	65	66	62	65
83	48	Standard Oil, N. J.....	32	33	32	33
48	31	Standard Oil, N. Y.....	2	2	1	1
9	1	Standard Plate Glass.....	59	59	56	57
86	55	Sun Oil.....	135	136	130	130
18	5	Swan & Finch.....	13	14	13	14
149	121	Swift & Co.....	55	56	53	54
20	9	Tennessee Copper & Chemical.....	55	62	54	61
71	50	Texas Corporation.....	21	21	19	20
85	42	Texas Gulf Sulphur.....	141	178	140	178
40	14	Tidewater Oil.....	78	90	76	90
530	111	Tubize Silk.....	45	46	43	44
140	59	Union Carbide.....	23	25	25	28
57	42	Union Oil, Cal.....	135	139	110	115
25	15	United Chemicals.....	7	9	7	7
48	15	United Piece Dye.....	24	27	21	26
243	95	U. S. Ind. Alcohol.....	95	96	93	96
35	5	U. S. Leather.....	49	69	49	66
65	15	U. S. Rubber.....	39	41	37	41
133	75	Vacuum Oil.....	5	7	5	6
116	37	Vanadium Corp.....	26	26	22	25
51	33	Vick Chemical.....	41	41	37	40
24	3	Va. Ca. Chemical.....	4	4	3	4
48	20	Wesson Oil.....	39	41	37	40
94	30	Westvac Chlorine.....	4	4	3	4
13	3	Wilson & Co.....	4	4	3	4

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Production of Chemicals Discloses Irregular Tendencies

Operations Vary According to Different Branches of the Industry

WITH THE publication of statistics descriptive of operations in the industries which are large consumers of chemicals, it becomes evident that a decided falling off in activities was experienced in December. The index of manufactures as reported by the Department of Commerce was 105 in November and 97 in December. During the same period the index for stocks increased from 157 to 158, showing that consumption declined at a slightly more rapid rate than production. With more particular reference to the chemical-consuming industries the following figures, showing actual production or consumption, are helpful in determining the relative disappearance of chemicals:

Consumption	Nov.	Dec.
Cotton consumed, bales.....	544,150	453,892
Wool consumed, 1,000 lb.....	46,694	37,803
Production		
Plate glass, 1,000 sq.ft.....	12,131	8,482
Glass containers, gross.....	2,274	1,963
Explosives, 1,000 lb.....	36,134	31,015
Byproduct coke, 1,000 tons.....	4,321	4,181
Automobiles:		
Passenger cars, no.....	217,570	119,950
Taxis, no.....	1,646	1,483
Trucks, no.....	46,642	27,233
Pneumatic tires, 1,000.....	2,654	2,441
Ethyl alcohol, 1,000 gal.....	20,898	16,262
Petroleum refined, 1,000 bbl.....	81,061	80,663
Rosin, wood, bbl.....	40,678	36,628
Turpentine, wood, bbl.....	7,498	7,068
Pine oil, gal.....	249,603	216,330

In the majority of cases, activities in November were below those of the preceding month and the position of consuming industries is sufficient proof that consumption of chemicals dropped off sharply in the last two months of the year.

THE new year opened with a continuance of the conditions which existed in the two preceding months. Some improvement was noted as the month progressed and some branches of the chemical industry were reported to be active, with a lagging tendency in other directions. Certain producers are known to be shipping out chemicals in larger volume than was the case a year ago, but this condition is by no means general and the irregular course of the industry adds to the conviction that the output of chemicals so far this year has been held below the standard of the corresponding period of last year.

The outlook, however, is regarded with optimism. Reports from such a basic industry as steel manufacture have

been highly encouraging. Construction programs also hold out much promise, and the general outlook is regarded as favorable for a successful year for chemicals. The rayon industry is carrying out a constructive program and while a surplus of used cars is presenting a dealer problem, production and sale of new automobiles promise to reach large proportions even though they do not come up to the record totals established last year.

BEARING on the outlook for business, was a report issue at the beginning of the year which stated that shippers of the country, through estimates of the Shippers' Regional Advisory Boards, anticipate that carload shipments of the 29 principal commodities in the first quarter of 1930 will be approximately 7,664,499 cars, a

Paint, Varnish, and Lacquer Sales Increase

TOTAL sales of paint, varnish and lacquer products during December, as reported to the Department of Commerce by 461 firms, aggregated \$19,155,398, as compared with \$25,514,494 in November and \$21,718,822 in December, 1928; total sales for the year 1929 are \$388,340,287, as compared to \$371,024,048 for 1928. This sum-

mary represents a revision of the data heretofore compiled and will be subject to further revisions as reports are received from additional concerns.

Of the thirteen Shippers' Regional Advisory Boards, five anticipate an increase in their respective districts in transportation requirements for the first quarter of the year compared with the same period last year, while eight expect a decrease. In practically every instance, however, the variation, compared with the same period last year, is small. The five boards which estimate an increase over the same period in the preceding year are the Atlantic States, Allegheny, Ohio Valley, Central Western, and Southwestern.

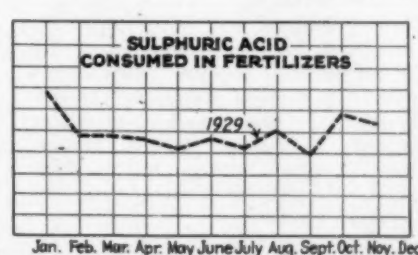
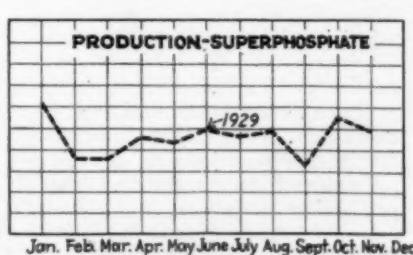
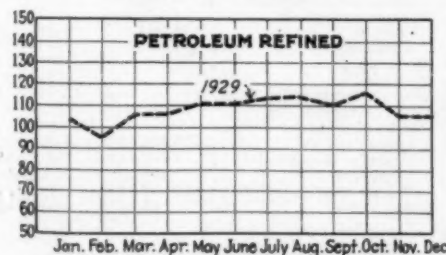
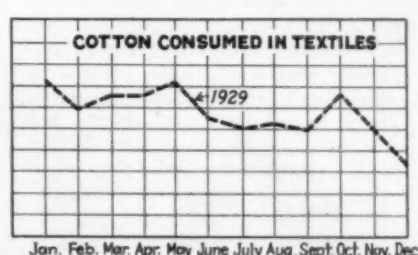
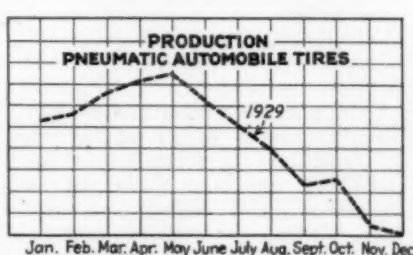
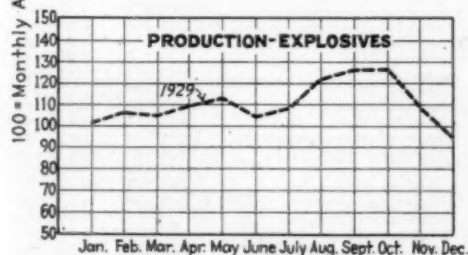
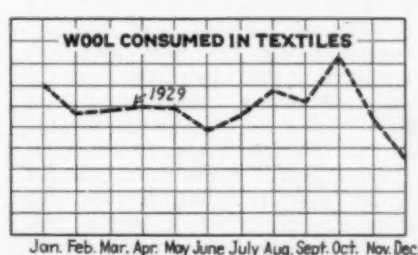
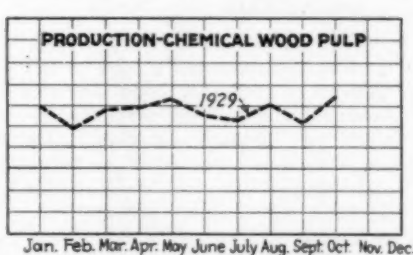
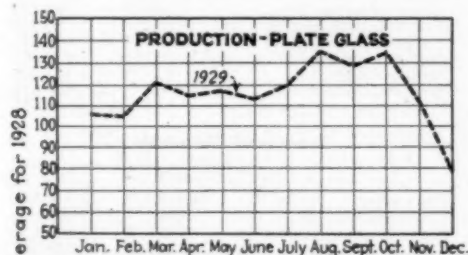
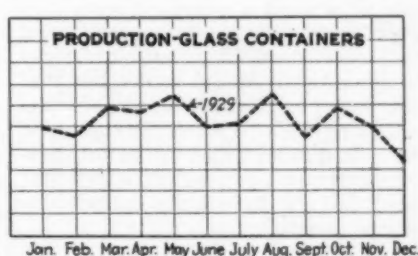
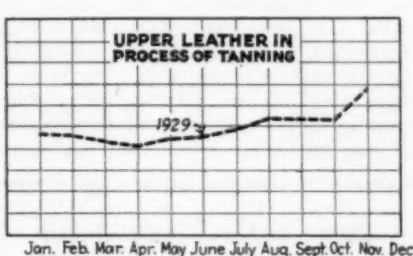
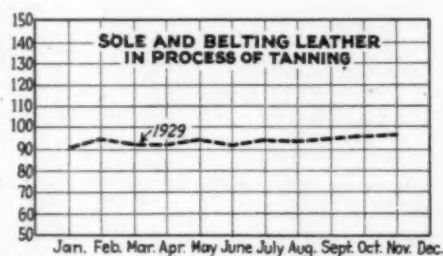
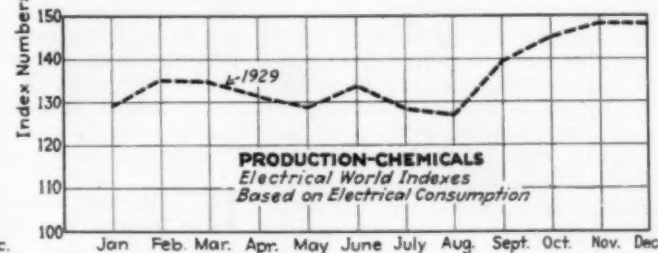
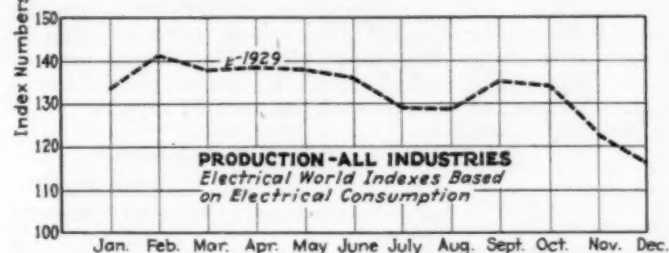
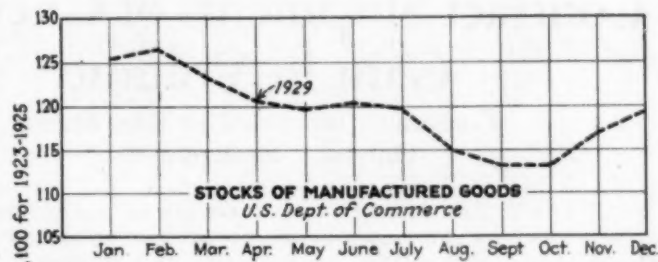
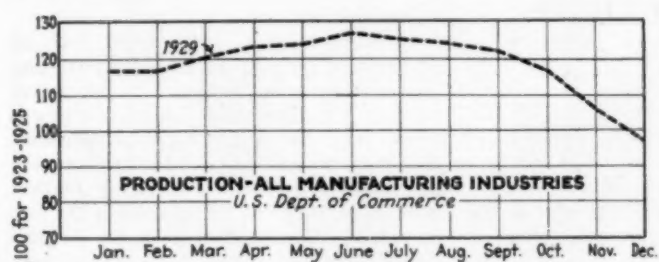
According to this report, shipments of cottonseed and products, except oil, would exceed those for the corresponding period of 1929 by 0.2 per cent; petroleum and petroleum products are estimated at a gain of 3.7 per cent; fertilizers at a gain of 1.6 per cent; paper, paper board, and prepared roofing, a gain of 1.9 per cent; and chemicals and explosives practically unchanged.

On Jan. 17 the Atlantic States Shippers' Advisory Board met and the report of the chemical committee indicated that shipments for the first quarter of the year would be in about the same proportion as in the 1929 period.

Detailed statistics are given below, by months, trade sales and industrial sales being shown separately. Trade sales include shipments to dealers, jobbers, painters and consumers; industrial sales are those to manufacturers, railroads, government, marine and all other similar users.

	Total Sales	Trade Sales	Industrial Sales	Not Specified
1929				
January.....	\$27,483,233	\$9,569,453	\$10,276,713	\$7,637,067
February.....	27,845,443	9,879,089	10,329,565	7,636,789
March.....	35,920,776	13,003,781	12,167,467	10,749,528
April.....	38,606,183	14,897,077	12,690,062	11,019,044
May.....	41,588,364	17,058,443	13,075,605	11,454,316
June.....	37,215,338	14,557,665	11,744,611	10,913,062
July.....	31,658,063	10,649,183	11,291,900	9,716,980
August.....	38,213,357	14,631,751	12,917,963	10,663,643
September.....	32,444,708	11,800,051	11,042,463	9,602,194
October.....	32,694,930	11,909,016	11,605,510	9,180,404
November.....	25,514,494	9,345,096	8,925,439	7,243,959
December.....	19,155,398	6,946,141	6,937,697	5,271,560
Total year.....	\$388,340,287	\$144,246,746	\$133,004,995	\$111,088,546
1928				
January.....	\$25,624,888	\$9,117,245	\$8,822,504	\$7,685,139
February.....	27,110,958	10,308,096	9,178,990	7,623,872
March.....	32,991,726	12,502,334	10,855,911	9,633,481
April.....	33,777,475	13,457,476	10,464,748	9,855,251
May.....	40,152,801	16,954,266	11,527,908	11,670,627
June.....	37,075,285	14,948,050	11,318,116	10,809,119
July.....	29,696,793	10,159,384	9,852,669	9,684,740
August.....	34,241,321	12,079,038	12,000,236	10,162,047
September.....	31,169,691	10,861,733	10,932,733	9,375,225
October.....	31,832,206	11,434,013	11,358,260	9,039,933
November.....	25,632,082	9,145,678	9,666,277	6,820,127
December.....	21,718,822	7,709,714	7,938,986	6,070,122
Total year.....	\$371,024,048	\$138,677,027	\$123,917,338	\$108,429,683

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



MARKET CONDITIONS and PRICE TRENDS

Contract Shipments of Chemicals Gain in Volume

Consumers Interested in Spot Market
Only in a Moderate Way

CONTRACT commitments for chemicals were placed in large volume in the final quarter of last year. Shipping instructions were deferred somewhat during the first half of January, but since then there has been a freer movement against contract holdings. In some cases consumers increased their requirements over last year and in other cases reductions were reported. The present movement of raw materials is described as normal, but is generally regarded as running slightly below the totals for the corresponding period of last year.

So far this year, the spot market has presented a quiet appearance with consumers restricting operation to actual needs. Evidence that unsold stocks have increased is found in the fact that prices have been unstable. This has been apparent not so much through open changes in quotations as in the competitive position of the market, which has enabled buyers to obtain concessions from the quoted levels.

COMPETITION has been especially keen among producers of solvents. Industrial alcohol has been unsettled. It is estimated that distribution of denatured alcohol is on a basis of 40,000,000 wine gal. for the anti-freeze trade; 25,000,000 wine gal. to the cellulose industry; 8,000,000 wine gal. for paint and varnish; 5,000,000 wine gal. to the toilet and perfume industry; and 15,000,000 wine gal. for miscellaneous purposes. The anti-freeze trade is well covered for the present season and has not been buying ahead to any large extent. Other consumers have bought in a conservative way and some producers have been eager to book orders not only for prompt but also for distant deliveries. Methanol, both the wood distillation and the synthetic products, has sold at lower levels and the increased output of synthetic has brought out selling pressure.

A good demand has been found for chromic acid, but the expansion of domestic production, together with larger arrivals from foreign producing centers, has brought the supply to a point where it exceeds demand. Recent reports credited importers with quoting shipments at prices lower than are current in the spot market.

Salt cake continues in light supply.

Outside of possible developments in the production of natural salt cake, there is very little prospect for an enlarged output. Domestic producers are well sold ahead and imported material likewise is passing direct to consumers without any appreciable gain in spot stocks. The latest import figures available are for last November, when 11,880,325 lb. was brought into this country.

IN THE vegetable oil trade considerable interest has been aroused by reports that copra production in the Philippine Islands may be affected by a crop pest. Definite information has not yet been received, but recent advices state that 6,000,000 trees are affected and that a campaign for eradicating the pest is under way. Arrivals of copra at Philippine terminals have been running light, but demand for coconut oil has not been active and prices for

oil in domestic markets have held at relatively low levels.

Consumption of linseed oil fell off in the last quarter of 1929 and trading has not yet been resumed on an active basis. On desirable business, prices have been shaded. Basic conditions, however, appear to be firm, and outside of fairly large stocks on hand, market influences seem to be against a decline in values. The seed crop in the Argentine is now estimated at 55,118,000 bu., as compared with 73,000,000 bu. for the preceding year, and the large drop in Argentine exportable should have a bullish effect if European oil centers buy in their accustomed manner.

Imports of Chemicals

	Jan.-Dec. 1928	Jan.-Dec. 1929
Dead or creosote oil, gal....	88,385,074	79,300,575
Pyridine, lb.....	54,616	40,114
Coal-tar acids, lb.....	2,946,121	1,973,153
Coal-tar intermediates, lb..	1,444,755	1,988,790
Coal-tar dyes, lb.....	6,252,157	7,593,119
Arsenic, lb.....	22,305,972	26,314,042
Acid, formic, lb.....	2,253,840	1,386,608
Acid, oxalic, lb.....	890,203	1,346,053
Acid, sulphuric, lb.....	26,327,631	16,208,111
Acid, tartaric, lb.....	1,913,016	2,220,324
Acid, acetic, lb.....		29,234,778
Ammonium chloride, lb....	11,023,523	9,560,513
Ammonium nitrate, lb....	13,172,099	9,495,613
Barium compounds, lb....	14,877,162	8,151,413
Calcium carbide, lb.....	2,527,215	3,773,320
Cobalt oxide, lb.....	364,154	475,928
Copper sulphate, lb.....	3,611,844	5,388,743
Bleaching powder, lb....	3,166,956	2,791,529
Magnesium compounds, lb..	17,310,996	17,928,445
Iodine, crude, lb.....	720,766	627,162
Glycerine, crude, lb.....	4,915,651	14,601,736
Potassium cyanide, lb....	115,583	137,343
Potassium carbonate, lb....	16,912,432	22,644,034
Caustic potash, lb.....	11,648,115	15,648,058
Cream of tartar, lb.....	159,059	181,252
Potassium chlorate, lb....	13,129,760	13,956,278
Sodium cyanide, lb.....	37,576,558	40,047,033
Sodium ferrocyanide, lb....	1,624,586	1,939,502
Sodium nitrite, lb.....	107,739	312,260
Sodium nitrate, ton.....	1,032,911	930,458
Sulphate of ammonia, ton..	42,066	18,812

Exports of Chemicals

	Jan.-Dec. 1928	Jan.-Dec. 1929
Benzol, gal.....	21,338,429	33,346,381
Crude coal-tar, bbl.....	138,153	108,590
Coal-tar intermediates, lb..	2,790,438	2,808,510
Coal-tar dyes, lb.....	27,824,264	34,129,597
Lead arsenate, lb.....	2,293,838	3,039,400
Calcium arsenate, lb.....	1,093,673	1,563,982
Acid, sulphuric, lb.....	7,000,293	6,959,829
Acid, boric, lb.....	3,382,183	5,203,881
Methanol, gal.....	523,810	498,481
Glycerine, lb.....	2,051,937	1,373,605
Acetone, lb.....	4,959,104	7,897,230
Formaldehyde, lb.....	2,368,086	2,588,169
Acetates, lb.....	841,564	698,367
Ammonium compounds, lb..	2,678,512	1,658,579
Aluminum sulphate, lb....	45,426,137	52,216,648
Acetate of lime, lb.....	11,172,685	101,198
Calcium carbide, lb.....	3,745,899	4,344,606
Bleaching powder, lb....	21,869,528	5,023,960
Calcium chloride, lb.....		30,850,858
Copper sulphate, lb.....	8,666,899	6,419,688
Potassium compounds, lb..	5,237,122	3,046,798
Sodium bichromate, lb....	8,692,088	5,855,293
Sodium cyanide, lb.....	1,522,393	1,815,861
Borax, lb.....	135,702,837	159,767,823
Sodium silicate, lb.....	59,325,626	66,734,993
Soda ash, lb.....	66,661,686 ¹	77,913,247
Salt soda		12,394,730
Sodium bicarbonate, lb....	18,711,148	18,941,851
Sodium sulphat, lb.....		3,331,630
Modified soda, lb.....		19,192,863
Caustic soda, lb.....	119,414,865 ²	117,390,422
Ammonia, anhydrous, lb....	1,907,867	2,416,558
Chlorine, lb.....	5,493,037	7,168,016
Sulphate of ammonia, ton..	93,015	145,189
Sulphur, ton.....	685,051	855,542

²Includes totals for salt soda.

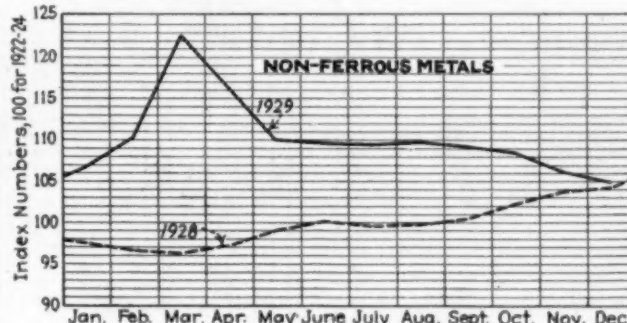
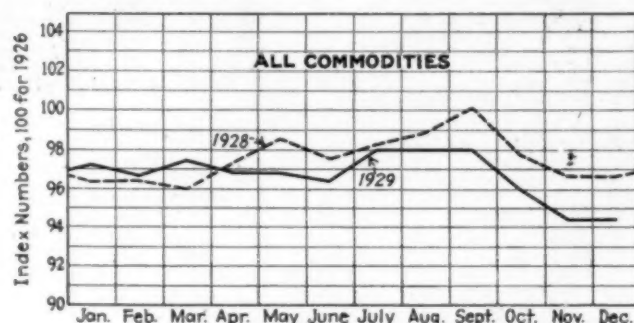
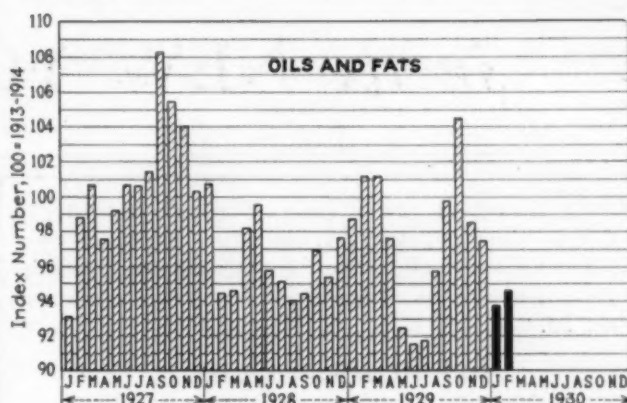
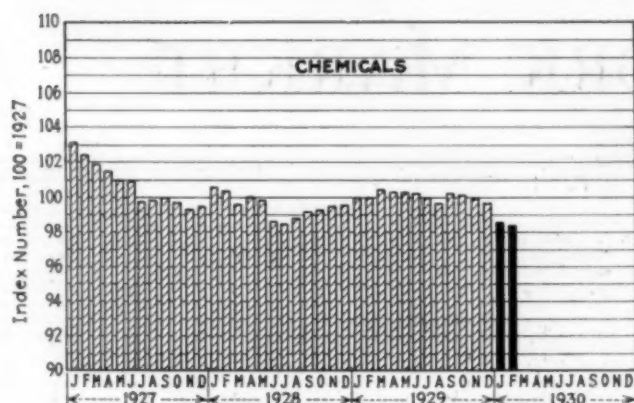
¹Includes totals for lye.

New Sales Method for Nitrate of Soda

The Nitrate Producers' Association has approved a plan to sell Chilean nitrate of soda by the association direct to retailers instead of through existing sales organizations, producers, or large distributors, states a cable from Commercial Attaché Ralph A. Ackerman, Santiago. The new plan, if approved by the Chilean government, will become effective July 1, 1930, and will cover all sales except for the United States and possessions.

The plan contemplates a central sales committee with headquarters in London to be composed of six members, one each to be named by the Nitrate Producers' Association, Chilean government, Lautaro Nitrate Company, Anglo-Chilean Consolidated Nitrate Corporation, Santiago Sabioncello, and one representative for the group of small producers. The committee, in conjunction with subcommittees located at strategical points, will direct sales allocations, contract for transportation and direct trade-promotion activities.

CHEM. & MET. *Weighted Indexes of* PRICES



Uncertain Outlook for Prices For Alcohol

RECENT developments in the market for industrial alcohol have brought out some uncertainty regarding the trend of values. Some consumers are hesitating to place long-term contracts, because of rumors to the effect that competitive conditions will depress values. Basically the market is in a very firm position, as blackstrap molasses is quoted at much higher levels than a year ago. None of the alcohol producers hold blackstrap contracts at anything like the price levels which were obtainable a year ago. Some producers are reported to be only partly covered on their raw materials and the general situation indicates higher producing costs than was the case in 1929. Corn will be used in making alcohol more extensively this year, but the capacity of

grain plants is only about 15,000,000 gal. of alcohol per year, and this capacity cannot be extended except at a large financial outlay.

It is evident therefore that the greater part of alcohol production must come from blackstrap. To produce 1 wine gal. of alcohol 2.7 gal. of blackstrap is required. Hence the raw-material cost, plus overhead and manufacturing expenses, makes it evident that current prices are relatively low.

Depressing influences have been found in reports that synthetic ethyl alcohol would become a market factor. These reports ultimately may prove true, but progress has not been rapid enough to expect any competition from this product in the near future. The lowering in prices for methanol has opened up some competition, but at present rate of production, the surplus supply of methanol will be able to take care of only a very small part of industrial alcohol requirements.

An analysis, therefore, of the situation does not reveal any real weakness in the alcohol market but rather emphasizes the strength which production costs may give to market values.

In the case of the majority of chemicals there is no decided price trend at present. Contract figures were announced in the latter part of last year, and probably they will not be subject to change. The stability of prices, however, may depend largely on the state of

business. If consumers operate actively, a firm market seems assured. Should consumption fall far behind production, there is the possibility of price cutting.

PROSPECTIVE prices for vegetable oils are closely connected with the uncertainty surrounding the tariff situation. The Senate has voted to increase the import duty on linseed oil from 3.7c. per pound to 4.5c. per pound. This action was taken as a compensatory measure for increasing the duty on flaxseed to 65c. per bushel. While the proposed duty on oil if enacted into law may serve to check foreign competition, the rate on flaxseed will be far more important as a market factor and the outcome undoubtedly favoring higher production costs for linseed oil with no assurance—especially when the vagaries of growing conditions are considered—that the home supply of flaxseed will be greatly extended.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	98.32
Last month	98.57
February, 1929	100.01
February, 1928	100.45

Firmer prices have ruled for carbon bisulphide, ethyl acetate, and tin salts but values in general showed an easier tone. Declines in methanol, chlorine, and turpentine more than offset any strength in other groups and the weighted index number for the month rested at a fractional decline.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	94.68
Last month	93.89
February, 1929	101.15
February, 1928	94.54

Many selections throughout the vegetable oil group sold at lower price levels during the period. This was especially true of China wood and castor oils. Crude cottonseed oil, however, was more firmly held and contributed largely to an advance in the weighted index number. Linseed oil showed practically no net change.

CURRENT PRICES

in the NEW YORK MARKET

THE following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Feb. 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.11-\$0.12	\$0.11-\$0.12	\$0.12-\$0.13
Acid, acetic, 28%, bbl., cwt.	3.88-4.03	3.88-4.03	3.88-4.03
Boric, bbl., lb.	.061-.07	.061-.07	.061-.07
Citric, kegs, lb.	.46-.47	.46-.47	.46-.47
Formic, bbl., lb.	.101-.11	.101-.11	.101-.11
Gallic, tech., bbl., lb.	.50-.55	.50-.55	.50-.55
Hydrofluoric 30% carb, lb.	.06-.07	.06-.07	.06-.07
Lactic, 44%, tech., light, bbl., lb.	.111-.12	.111-.12	.12-.121
22%, tech., light, bbl., lb.	.051-.06	.051-.06	.051-.06
Muriatic, 18%, tanks, cwt.	1.00-1.101	1.00-1.10	.90-1.00
Nitric, 36%, carboys, lb.	.05-.051	.05-.051	.05-.051
Oleum, tanks, wks., ton.	18.50-20.00	18.50-20.00	18.00-20.00
Oxalic, crystals, bbl., lb.	.111-.114	.111-.114	.11-.111
Phosphoric, tech., c. bys., lb.	.081-.09	.081-.09	.081-.09
Sulphuric, 60%, tanks, ton.	11.00-11.50	11.00-11.50	11.00-11.50
Tannic, tech., bbl., lb.	.35-.40	.35-.40	.35-.40
Tartaric, powd., bbl., lb.	.381-.39	.381-.39	.38-.39
Tungstic, bbl., lb.	1.40-1.50	1.40-1.50	1.00-1.20
Alcohol, ethyl, 190 p.f., bbl., gal.	2.63-2.71	2.63-2.71	2.681-2.71
Alcohol, Butyl, tanks, lb.	.161-.17	.161-.17	.161-.19
Alcohol, Amyl, dr. gal.	1.90-2.10		
From Pentane, tanks, lb.	2.36-2.40		
Denatured, 190 proof			
No. 1 special dr., gal.	.49-50	.51-50	.46-46
No. 5, 188 proof, dr., gal.	.50-50	.50-50	.46-46
Alum, ammonia, lump, bbl., lb.	.031-.04	.031-.04	.031-.04
Chrome, bbl., lb.	.051-.051	.051-.051	.051-.05
Potash, lump, bbl., lb.	.03-.031	.03-.031	.021-.031
Aluminum sulphate, com., bags, cwt.	1.40-1.45	1.40-1.45	1.40-1.45
Iron free, bg., cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Aqua ammonia, 26%, drums, lb.	.03-.04	.03-.04	.03-.04
Ammonia, anhydrous, cyl., lb.	.15-.15	.15-.15	.131-.13
Ammonium carbonate, powd., tech., caaks, lb.	.121-.13	.12-.13	.12-.13
Sulphate, wks., cwt.	2.10-2.10	2.10-2.10	2.30-2.30
Amylacetate tech., drums, gal.	1.70-1.90	1.70-1.90	1.75-2.00
Syn ho ic, tanks, lb.	.222-.22		
Antimony Oxide, bbl., lb.	.09-.10	.09-.10	.09-.10
Arsenic, white, powd., bbl., lb.	.04-.041	.04-.041	.04-.041
Red, powd., kegs, lb.	.091-.10	.09-.10	.09-.10
Barium carbonate, bbl., ton.	58.00-60.00	58.00-60.00	57.50-60.00
Chloride, bbl., ton.	63.00-65.00	65.00-67.00	64.00-70.00
Nitrate, caak, lb.	.07-.071	.071-.08	.08-.081
Blanc fixe, dry, bbl., lb.	.031-.04	.031-.04	.04-.041
Bleaching powder, f.o.b., wks., drums, cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Borax, bbl., lb.	.033-.033	.033-.033	.021-.03
Bromine, cs., lb.	.45-.47	.45-.47	.45-.47
Calcium acetate, bags, cwt.	4.50-4.50	4.50-4.50	4.50-4.50
Arsenate, dr., lb.	.07-.08	.07-.10	.061-.07
Carbide drums, lb.	.05-.06	.05-.06	.05-.06
Chloride, fused, dr., wks., ton.	22.50-20.00	20.00-20.00	20.00-20.00
Fluophosphate, bbl., lb.	.08-.081	.08-.081	.07-.071
Carbon bisulphide, drums, lb.	.051-.06	.05-.06	.05-.06
Tetrachloride drums, lb.	.061-.07	.061-.07	.061-.07
Chlorine, liquid, tanks, wks., lb.	.021-.02	.021-.02	.03-.03
Cylinders	.041-.06	.041-.06	.05-.08
Cobalt oxide, cans, lb.	2.10-2.20	2.10-2.20	2.10-2.25
Copperas, bags, f.o.b. wks., ton.	15.00-16.00	15.00-16.00	16.00-17.00
Copper carbonate, bbl., lb.	.13-.20	.13-.20	.17-.18
Cyanide, tech., bbl., lb.	.49-.50	.49-.50	.49-.50
Sulphate, bbl., cwt.	5.50-6.00	5.50-6.00	5.63-5.75
Cream of tartar, bbl., lb.	.261-.27	.261-.27	.271-.28
Diethylene glycol, dr., lb.	.10-.15	.10-.15	.10-.15
Epsom salt, dom., tech., bbl., cwt.	1.75-2.15	1.75-2.00	1.75-2.00
Imp., tech., bags, cwt.	1.15-1.25	1.15-1.25	1.15-1.25
Ethyl acetate, drums, lb.	1.18-1.09	1.09-.071	1.25-1.25
Formaldehyde, 40%, bbl., lb.	.071-.08	.071-.08	.091-.10
Furfural, dr., lb.	.15-.171	.15-.171	.15-.17
Fusel oil, crude, drums, gal.	1.30-1.40	1.30-1.40	1.30-1.40
Refined, dr., gal.	1.90-2.00	1.90-2.00	2.50-3.00
Galubers salt, bags, cwt.	1.10-1.20	1.10-1.20	1.00-1.10
Glycerine, c.p., drums, extra., lb.	.14-.141	.14-.141	.14-.15
Lead:			
White, basic carbonate, dry caaks, lb.	.081-.081	.081-.081	.081-.081
White, basic sulphate, sek., lb.	.08-.08	.08-.08	.071-.071
Red, dry, sek., lb.	.091-.091	.091-.091	.091-.091
Lead acetate, white crys., bbl., lb.	.13-.14	.13-.14	.13-.131
Lead arsenate, powd., bbl., lb.	.14-.15	.14-.15	.12-.13
Lime, chem., bulk, ton.	8.50-8.50	8.50-8.50	8.50-8.50
Litharge, powd., sek, lb.	.081-.081	.081-.081	.081-.081
Lithopone, bags, lb.	.051-.06	.051-.06	.051-.061
Magnesium carb., tech., bags, lb.	.06-.061	.06-.061	.061-.07
Methanol, 95%, tanks, gal.	.43-.43	.43-.43	.55-.55
97%, tanks, gal.	.45-.45	.45-.45	.55-.55
Synthetic, tanks, gal.	.43-.45		

	Current Price	Last Month	Last Year
Nickel salt, double, bbl., lb.	13-131	13-131	10-11
Single, bbl., lb.	13-131	13-131	101-111
Orange mineral, cak., lb.	10 111	\$0.111	\$0.111
Phosphorus, red, caaks, lb.	.42-.44	.42-.44	.62-.65
Yellow, caaks, lb.	.31-.32	.31-.32	.32-.33
Potassium bichromate, caaks, lb.	.09-.091	.09-.091	.09-.091
Carbonate, 80-85%, calc., cak., lb.	.051-.06	.051-.06	.051-.06
Chlorate, powd., lb.	.081-.09	.081-.09	.061-.07
Cyanide, cs., lb.	.52-.55	.52-.55	.51-.53
First sort, cak., lb.	.081-.09	.081-.09	.081-.09
Hydroxide (c'stic potash) dr., lb.	.061-.061	.061-.061	.071-.071
Muriate, 80% bgs., ton.	36.75-36.75	36.75-36.75	36.40-36.40
Nitrate, bbl., lb.	.06-.061	.06-.061	.06-.071
Permanganate, drums, lb.	.16-.161	.16-.161	.15-.16
Prussiate, yellow, caaks, lb.	.181-.191	.181-.191	.18-.19
Sal ammoniac, white, caaks, lb.	.046-.05	.046-.05	.047-.05
Salsoda, bbl., cwt.	.90-.95	.90-.95	.90-.95
Salt cake, bulk, ton.	22.00-24.00	22.00-24.00	15.00-17.00
Soda ash, light, 58%, bags, contract, cwt.	1.32-1.35	1.32-1.35	1.32-1.35
Dense, bags, cwt.	1.35-1.35	1.35-1.35	1.35-1.35
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90-3.00	2.90-3.00	2.90-3.00
Acetate, works, bbl., lb.	.04-.041	.041-.05	.051-.06
Bicarbonate, bbl., cwt.	2.00-2.25	2.00-2.25	2.00-2.25
Bichromate, caaks, lb.	.07-.071	.07-.071	.07-.071
Bisulphate, bulk, ton.	16.00-18.00	16.00-18.00	3.00-3.50
Bisulphite, bbl., lb.	.031-.04	.031-.031	.031-.04
Chlorate, kegs, lb.	.071-.08	.071-.08	.061-.061
Chloride, tech., ton.	12.00-14.75	12.00-14.75	12.00-14.00
Cyanide, caaks, dom., lb.	.18-.22	.18-.22	.18-.22
Fluoride, bbl., lb.	.081-.091	.081-.091	.081-.09
Hyposulphite, bbl., lb.	2.40-2.50	2.40-2.50	2.50-3.00
Nitrate, bags, cwt.	2.10-2.10	2.10-2.10	2.15-2.15
Nitrite, caaks, lb.	.071-.08	.071-.08	.071-.08
Phosphate, dibasic, bbl., lb.	.031-.031	.031-.031	.031-.031
Prussiate, yel drums, lb.	.111-.12	.111-.12	.111-.12
Silicate (30% drums), cwt.	.70-.80	.70-.80	.75-1.15
Sulphide, fused, 60-62%, dr., lb.	.021-.031	.021-.031	.031-.04
Sulphite, cyrs., bbl., lb.	.03-.031	.021-.03	.021-.03
Strontium nitrate, bbl., lb.	.03-.031	.03-.031	.021-.031
Sulphur, crude at mine, bulk, ton	18.00-18.00	18.00-18.00	18.00-18.00
Chloride, dr., lb.	.05-.06	.04-.05	.04-.05
Dioxide, cyl., lb.	.07-.08	.07-.08	.09-.10
Flour, bag, cwt.	1.55-3.00	1.55-3.00	1.55-3.00
Tin bichloride, bbl., lb.	.13-.13	.13-.13	.151-.151
Oxide, bbl., lb.	.42-.42	.42-.42	.54-.54
Crystals, bbl., lb.	.32-.32	.32-.32	.371-.371
Zinc chloride, gran., bbl., lb.	.061-.061	.061-.061	.061-.061
Carbonate, bbl., lb.	.101-.11	.101-.11	.10-.11
Cyanide, dr., lb.	.41-.42	.40-.41	.40-.41
Dust, bbl., lb.	.08-.081	.081-.09	.09-.10
Zinc oxide, lead free, bag, lb.	.061-.061	.061-.061	.061-.061
5% lead sulphate, bags, lb.	.061-.061	.061-.061	.061-.061
Sulphate, bbl., cwt.	3.00-3.25	2.75-3.00	2.75-3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.121-\$0.13	\$0.121-\$0.13	\$0.121-\$0.13
Chinawood oil, bbl., lb.	.121-.131	.131-.131	.15-.15
Coconut oil, Ceylon, tanks, N.Y., lb.	.07-.071	.071-.071	.081-.081
Corn oil crude, tanks, (f.o.b. mill), lb.	.071-.071	.071-.071	.081-.081
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.071-.071	.07-.071	.09-.09
Linseed oil, raw, car lots, bbl., lb.	.14-.14	.14-.14	.102-.102
Palm, Lagos, caaks, lb.	.071-.071	.071-.071	.091-.091
Niger, caaks, lb.	.07-.071	.071-.071	.09-.09
Palm Kernel, bbl., lb.	.071-.071	.071-.071	.091-.091
Peanut oil, crude, tanks (mill), lb.	.071-.071	.071-.071	.10-.10
Rapeseed oil, refined, bbl., gal.	.71-.73	.71-.73	.83-.85
Soya bean, tank (f.o.b. Coast), lb.	.091-.091	.091-.091	.091-.091
Sulphur (olive foots), bbl., lb.	.071-.08	.08-.08	.101-.101
Cod, Newfoundland, bbl., gal.	.59-.60	.57-.68	.65-.67
Menhaden, light pressed, bbl., gal.	.67-.71	.64-.66	.60-.61
Crude, tanks (f.o.b. factory), gal.	.45-.45	.45-.45	.48-.48
Whale, crude, tanks, gal.	.78-.80	.80-.80	.78-.78
Grease, yellow, loose, lb.	.061-.061	.061-.061	.071-.071
Oleo stearine, lb.	.111-.111	.111-.111	.091-.091
Red oil, distilled, d.p. bbl., lb.	.101-.11	.091-.10	.091-.091
Tallow, extra, loose, lb.	.07-.071	.071-.071	.081-.081

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	\$0.60-\$0.65	\$0.60-\$0.65	\$0.60-\$0.62
Refined, bbl., lb.	.80-.85	.80-.85	.85-.90
Alpha-naphthylamine, bbl., lb.	.32-.34	.32-.34	.35-.36
Aniline oil, drums, extra, lb.	.15-.151	.141-.15	.15-.16
Aniline salts, bbl., lb.	.24-.25	.24-.25	.24-.25
Anthracene, 80%, drums, lb.	.60-.65	.60-.65	.60-.65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.22 - .24	.23 - .25	.22 - .23
Beta-naphthol, tech. drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.73 - .75	.73 - .75	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluen., bbl., lb.	.16 - .17	.17 - .18	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.39 - .40	.42 - .43	.45 - .47
H-acid, bbl., lb.	.68 - .70	.65 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.044 - .05	.044 - .05	.05 - .06
Nitrobenzene, dr., lb.	.09 - .10	.09 - .10	.084 - .10
Para-nitraniline, bbl., lb.	.51 - .55	.55 - .56	.52 - .53
Para-nitrotoluene, bbl., lb.	.28 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.144 - .15	.144 - .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.75 - 1.90	1.75 - 1.90	1.35 - 1.50
P-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .49
Resorcinol, tech., kgs., lb.	1.25 - 1.30	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., lb.	.33 - .35	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks, gal.	.30 - .35	.30 - .35	.35 - .36
Toluidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.40 - .45	.45 - .45	.35 - .36
Xylene, com., tanks, gal.	.28 - .30	.30 - .35	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	\$23.00-\$25.00	\$23.00-\$25.00	\$23.00-\$25.00
Casein, tech., bbl., lb.	.144 - .15	.144 - .15	.164 - .17
China clay, dom., f.o.b. mine, ton	10.00 - 20.00	10.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.06 - .13	.06 - .13	.064 - .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramarine blue, bbl., lb.	.06 - .32	.06 - .32	.01 - .35
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner, lb.	.75 - .80	.75 - .80	.70 - .80
Vermilion, English, bbl., lb.	1.90 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .174	.17 - .174	.15 - .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.04 - .05	.04 - .05	.08 - .09
Cum copal Congo, bags, lb.	.074 - .08	.074 - .08	.074 - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases, lb.	.21 - .22	.21 - .22	.22 - .23
Kauri No. 1 cases, lb.	.45 - .50	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc., ton	40.00 - .07	40.00 - .07	40.00 - .07
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, caeks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	8.70 - .554	8.70 - .554	9.50 - .59
Turpentine, gal.	.544 - .554	.564 - .59	.59 - .61
Shellac, orange, fine, bags, lb.	.59 - .60	.59 - .60	.61 - .62
Bleached, bonedry, bags, lb.	.46 - .48	.46 - .48	.56 - .60
T. N. bags, lb.	.33 - .35	.35 - .36	.46 - .47
Soapstone (f.o.b. Vt.), bags, ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	9.50 - .750	9.50 - .750	10.50 - .750
300 mesh (f.o.b. Ga.), ton.	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 - .13.75	13.75 - .13.75	13.75 - .1

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	\$0.27 - \$0.29	\$0.27 - \$0.29	\$0.31 - \$0.32
Beeswax, ref., light, lb.	.37 - .39	.37 - .40	.41 - .42
Candelilla, bags, lb.	.21 - .23	.21 - .23	.23 - .24
Carnauba, No. 1, bags, lb.	.32 - .33	.32 - .34	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.041 - .05	.041 - .05	.041 - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.	\$200.00 - .	\$200.00 - .	\$200.00 - .
Ferromanganese, 78-82%, ton.	100.00 - .	105.00 - .	105.00 - .
Spiegelisen, 19-21%, ton.	33.00 - .	33.00 - .	32.00 - .
Ferrosilicon, 14-17%, ton.	45.00 - .	45.00 - .	45.00 - .
Ferrotungsten, 70-80%, lb.	1.45 - .	1.45 - .	1.35 - .98
Ferro-uranium, 35-50%, lb.	4.50 - .	4.50 - .	4.50 - .
Ferrovandium, 30-40%, lb.	3.15 - 3.75	3.15 - 3.75	3.15 - 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	\$0.174 - .	\$0.174 - .	\$0.164 - .
Aluminum, 96-99%, lb.	.24 - .30	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.084 - .	.084 - .	.094 - .
Nickel, 99%, lb.	.35 - .	.35 - .	.35 - .
Monel metal, blocks, lb.	.28 - .	.28 - .28	.28 - .
Tin, 5-ton lots, Straits, lb.	.384 - .	.394 - .	.49 - .
Lead, New York, spot, lb.	.064 - .	.064 - .	.064 - .
Zinc, New York, spot, lb.	.056 - .	.056 - .	.067 - .
Silver, commercial, oz.	.434 - .	.454 - .	.564 - .
Cadmium, lb.	.85 - .95	.85 - .95	.85 - .95
Bismuth, ton lots, lb.	1.70 - .	1.70 - .	1.70 - .
Cobalt, lb.	2.10 - 2.50	2.10 - 2.50	2.50 - .
Magnesium, ingots, 99%, lb.	.85 - 1.10	.85 - 1.10	.85 - 1.10
Platinum, ref., oz.	61.00 - 65.00	62.00 - 66.00	70.00 - 70.00
Palladium, ref., oz.	35.00 - 36.00	35.00 - 36.00	42.00 - 46.00
Mercury, flask, 75 lb.	120.00 - .	123.50 - .	118.00 - .
Tungsten powder, lb.	1.35 - 1.50	1.35 - 1.50	1.10 - 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.	\$7.50 - \$8.00	\$7.50 - \$8.50	\$5.50 - \$8.75
Chrome ore, c.f. post, ton.	21.50 - 25.00	21.50 - 25.00	22.00 - 23.00
Coke, fdry., f.o.b. ovens, ton.	2.75 - 2.85	2.75 - 3.85	2.85 - 3.00
Fluorspar, gravel, f.o.b. Ill., ton.	18.00 - 20.00	18.00 - 20.00	17.00 - 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit.	.31 - .36	.31 - .36	.36 - .38
Molybdenite, 85% MoS ₂ per lb.	.48 - .50	.48 - .50	.48 - .50
Monazite, 6% of ThO ₂ , ton.	60.00 - .	60.00 - .	130.00 - .
Pyrites, Span. fines, c.i.f. unit.	.13 - .	.13 - .	.13 - .
Rutile, 94-96% TiO ₂ , lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO ₃ and over, unit.	15.25 - 16.50	15.25 - 16.50	11.25 - 11.50
Vanadium ore, per lb. V ₂ O ₅ , lb.	28.00 - .	.28 - .	nom. - nom.
Zircon, 99%, lb.	.03 - .	.03 - .	.03 - .

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Asphalt Plant—Barrett Co. Ltd., Villiers St., Toronto, Ont., plans the construction of an asphalt plant at Dundas. Estimated cost \$100,000. Private plans. Asphalt storage and handling equipment will be required.

Asphalt Plant—W. P. McDonald Construction Co., Lawrence St. and Broadway, Flushing, N. Y., plans the construction of a 1 story, 30 x 65 ft. asphalt plant. Estimated cost \$22,000. M. Kramer, c/o owner, is architect.

Aluminum Factory—Aluminum Co. of Canada, 158 Sterling R., Toronto, Ont., awarded contract for the construction of a 1 story addition to aluminum factory to A. R. Holmes Ltd. 6 Hayden St., Toronto. Estimated cost \$75,000.

Alloy Factory—Ohio Ferro-Alloy Corp., Witters Bldg., Canton, O., plans the construction of a 1 story, 80 x 60 ft. factory at Philo. Estimated cost \$50,000 to \$75,000. Private plans. Steel contract let.

Bronze Plant Addition—Frontier Bronze Co., 818 Elmwood Ave., Niagara Falls, N. Y., plans addition to bronze plant. Estimated cost \$40,000.

Foundry and Fabrication Mill—General Bronze Co., 1665 Booth St., Milwaukee, Wis., plans West 42nd St., New York, N. Y., awarded con-

tract for the construction of a 2 story factory at 6th Ave. and Washington St., Long Island City, to Wilcox Construction Co., 1 Bridge Pl., Long Island City, N. Y. Estimated cost \$60,000.

Bakelite Plant—Bakelite Corp., 230 Grove St., Bloomfield, N. J., will soon award contract for the construction of a 3 story, 135 x 55 x 155 ft. bakelite plant. Estimated cost \$100,000. R. Bolton, 45 Branford Pl., Newark, is architect.

Brick Plant—Columbia Brick Co., D. Sowell and R. L. Vaughan, Columbia, Tenn., plans remodeling plant, including two kilns, equipment, etc., 250,000 brick capacity.

Cement Plant—Alpha Portland Cement Co., Jamestown, N. Y., awarded contract for the construction of a cement plant, storage facilities, etc. to Burrell Engineering & Construction Co., 1 North Carol St. W., Chicago, Ill. Estimated cost to exceed \$40,000.

Cement Plant—Huron Portland Cement Co., 840 Water St., Toledo, O., awarded contract for the construction of a cement warehouse and silos to Burrell Engineering & Construction Co., 840 Water St., Toledo. Estimated cost \$150,000.

Colorcraft Factory—Colorcraft Corp., 122 West 42nd St., New York, N. Y., awarded con-

tract for the construction of a 2 story factory at 6th Ave. and Washington St., Long Island City, to Wilcox Construction Co., 1 Bridge Pl., Long Island City, N. Y. Estimated cost \$60,000.

Carbonic Engine Room—L. L. Ransom, 15 Park Row, New York, N. Y., archt., will receive bids about Mar. 1 for the construction of a 1 story, 45 x 60 ft. engine room at Newark, N. J., for Natural Carbonic Gas Co., McClellan St., Newark. Estimated cost \$40,000.

Coke Ovens—Colorado Fuel & Iron Co., A. Raeder, Pres., Boston Bldg., Denver, Colo., awarded contract for 31 by-product coke oven additions to steel works at Pueblo to Koppers Construction Co., Union Trust Bldg., Pittsburgh, Pa. Estimated cost \$1,000,000.

Coke Ovens—Donner-Hanna Coke Corp., Abby and Mystic Sts., Buffalo, N. Y., plans to expend \$2,000,000 for a battery of 51 coke ovens at South Buffalo plant.

Coke Screening Plant and Equipment—Danbury & Bethel Gas & Electric Light Co., 238 Main St., Danbury, Conn., awarded contract for the construction of a 1 story coke screening plant, also installing crushing, sizing and

screening machinery on Pahquioque Ave. Estimated cost to exceed \$40,000.

Carbonic Gas Manufacturing Plants—Liquid Carbonic Co., 3100 South Kedzie Ave., Chicago, Ill., plans the construction of a gas manufacturing plant at Seattle, Wash. \$300,000, also plans addition to plant at Tulip and Tioga Sts., Philadelphia, Pa. \$100,000. Private plans.

Concrete Plant—Toronto Ready Mix Concrete Ltd., Fleet St., Toronto, Ont., plans the construction of two new plants including equipment. Estimated total cost \$140,000. Private plans.

Cotton Compress Plant—Hardy & Curran, Corpus Christi, Tex., are having plans prepared for the construction of a cotton compress plant, 30,000 bale capacity. Estimated cost \$150,000.

Cresosote Plant—Cresco-Dipt Co., R. T. Nairn, Mgr., 1118 Leary Way, Seattle, Wash., will start work immediately on a new cresosote plant. Estimated cost \$50,000.

Dry Ice Plant—Carbon Dioxide & Chemical Co., c/o M. P. Smith, V. Pres., Salt Lake City, Utah, plans the construction of a dry ice plant for using dioxide gas discovered on the Farnum Dome, Farnum, present flow 12,000,000 cu. ft. per day. Estimated cost \$100,000.

Dry Ice Plant—St. Louis Carbonic Ice Co., 813 Hemstead St., St. Louis, Mo., is having preliminary plans prepared for the construction of a plant to produce vapor ice, a dry refrigerant and carbonic gas at Valley Park. Estimated cost \$300,000.

Drying Oven Building—Multibestos Co., G. Putnam, Pres., South St., Walpole, Mass., awarded contract for additions and alterations to factory, 2 story, 36 x 80 ft. to Dacey & Tibbets, Inc., 40 Court St., Boston. Estimated cost \$40,000.

Enameling Plant—American Can Co., J. G. Leonard, Ogden, Utah, plans the construction of a 1 story, 79 x 310 ft. enameling plant. Estimated cost \$40,000.

Enameling Plant—Tennessee Stove Works, Main and Belt Ry., Chattanooga, Tenn., plans additions to plant including the erection of an enameling plant. Estimated cost \$200,000.

Gas Apparatus, Gas Plant, etc.—New Haven Gas Light Co., H. L. Sterrett, 50 Crown St., New Haven, Conn., plans remodeling gas apparatus, gas plant to house entire operating department, garage and storage building, 12 mi. mains, etc. Estimated cost \$600,000. Private plans.

Gas Manufacturing System—F. C. Handy, City Clk., Ukiah, Calif., plans to purchase a Commercial (Buane) gas manufacturing system.

Gas Plant—J. Burkett, et al., 306 Terrell Ave., San Antonio, Tex., is having plans prepared for the construction of a butane gas plant at Kerrville for domestic use. This gas will be manufactured from liquid butane shipped to Kerrville under pressure at 3200 British thermal units per cu. ft. and reduced to 500 thermal units for local distribution. Estimated cost \$50,000. Plant will be operated by Border Cities Gas Co.

Helium Plant—U. S. Government, Bureau of Mines, Washington, D. C., appropriated \$80,000 for addition to helium plant at Amarillo, Tex.

Gasoline Plant—Cromwell Franklin Oil Co., Oklahoma City, Okla., is having preliminary plans prepared for the construction of a casinghead gasoline plant. Estimated cost \$50,000. Private plans.

Gasoline Plant—Empire Co., Bartlesville, Okla., will build a casinghead gasoline plant at Konawa. Estimated cost \$25,000. Private plans.

Gasoline Plant—Indian Territory Illuminating Oil Co., Bartlesville, Okla., is having preliminary plans prepared for the construction of a casinghead gasoline plant in Oklahoma City. Estimated cost \$50,000. Private plans.

Gasoline Plant—Phillips Petroleum Co., Bartlesville, Okla., is having preliminary plans prepared for the construction of a casinghead gasoline plant at Oklahoma City. Estimated cost \$60,000. A. H. Riney, Bartlesville, is engineer.

Glass Factory—Oil City Glass Bottle Co., R. R. Underwood, Pres., Marienville, Pa., subsidiary of Knox Glass Bottle Co., Clarion, awarded contract for a 1 story, 50 x 200 ft. glass factory at McClintockville Flats to Clarion Blox Co., Clarion. Private plans.

Glass Furnace Building—The Hocking Glass Co., Lancaster, O., awarded contract for the construction of a 2 story, 60 x 120 ft. glass furnace building to The Austin Co., 18112 Euclid Ave., Cleveland, O. Estimated cost \$40,000.

Graphite Factory—International Graphite & Electrode Corp., Niagara Falls, N. Y., W. A. Harty, Pres., c/o Exolon Co., Bladell, N. Y., plans the construction of a graphite factory at Pine Ave. near Packard Rd., Niagara Falls. Private plans.

Gypsum Factory—Canada Gypsum Ltd., R. E. Haire, Pres. and Gen. Mgr., Paris, Ont., is having plans prepared for the construction of a factory for the manufacture of gypsum tile and wall plaster at Calgary, Alta. Estimated cost \$150,000. Interested in prices on equipment. A plaster board mill will be erected later.

Incandescent Lamp Plant—Mexican Electric Lamp Co. Inc., Monterrey, Mexico, awarded contract for the construction of an incandescent lamp plant to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost \$500,000.

Kilns—Hall China Co., East Liverpool, O., awarded contract for the construction of two tunnel kilns one 355 ft. long to be Multi-Burner type and other 301 ft. long to American Dressler Tunnel Kiln Co., Inc., Walnut and 12th Sts., Cleveland. Estimated cost \$150,000.

Kiln, Making and Castings Building—Locke Insulator Co., Charles and Cromwell Sts., Baltimore, Md., awarded contract for the construction of a kiln, also making and castings buildings to C. L. Stockhausen Co., Gay and Water Sts., Baltimore.

Chemical Factory—Ohio Chemical & Mfg. Co., J. G. Sholer, Pres., East 55th St. and Marquette Rd., Cleveland, O., awarded contract for a 1 story, 53 x 77 ft. addition to factory to Albert M. Higley Co., Plymouth Bldg., Cleveland. Estimated cost \$40,000.

Chemical Factory—Richards Co., Ludlow St., Stamford, Conn., awarded contract for the construction of a 1 story, 40 x 80 ft. chemical factory on Ludlow St. to J. W. Ferguson Co., Paterson. Estimated cost \$20,000.

Chemistry Building—University of Illinois, Urbana, Ill., awarded contract for the construction of a 50 x 200 ft. chemistry building to A. W. Stoolman, Champaign, Ill. Estimated cost \$335,000.

Laboratory (Chemical)—Bd. of Education, Beaver Falls, Pa., awarded contract for a 2 story, 150 x 292 ft. high school including chemical laboratory, etc., on 8th Ave. to R. B. McDaniel, 4th Ave. and 7th St., New Brighton, Pa. Estimated cost \$600,000.

Laboratory (Chemical)—W. W. Potter, Real Estate Trust Bldg., Philadelphia, Pa., Archt., will soon receive bids for the construction of a 3 story, 38 x 132 ft. chemical laboratory at Bristol for Rohn & Haas Co., 222 West Washington Sq., Philadelphia.

Laboratory (Physics)—Fordham University, Fordham Rd., New York, N. Y., is receiving bids for the construction of a physics laboratory. Estimated cost \$300,000. E. G. Perrot, 130 West 42nd St., New York, is architect. Steel contract, etc.

Laboratory—University of Cincinnati, Clifton Ave., Cincinnati, O., received lowest bid for the construction of a 3 story, 52 x 93 ft. laboratory from Penker Construction Co., 1030 Summer St., Cincinnati. Estimated cost \$130,000.

Laboratories—New York Hospital-Cornell Medical College Association, New York, N. Y., awarded contract for second unit of medical center including laboratories, power plant, laundry, etc. at East 70th and 71st Sts., York Ave. and Exterior St. to Marc Eidlitz, 41 East 42nd St., New York.

Leather Factory Addition—J. S. Barnett & Sons, 128 Boston St., Lynn, Mass., will soon award contract for a 1 story, 50 x 200 ft. addition to leather factory. Estimated cost \$40,000. C. L. Betton, 31 Exchange St., Lynn, is architect.

Lime Manufacturing Plant—Gypsum Lime & Alabastine Co., Paris, Ont., is having plans prepared for extensions and improvements to plant including new kilns, machinery, etc. at Beachville. Estimated cost \$100,000. W. Sheppard, Paris, is chief engineer.

Molasses Factory—Pacific Molasses Co., Ltd., Terminal Island, San Pedro, Calif., plans an expansion program for 1930; storage capacity of plant will be increased from 63,000 to 100,000 ton.

Paint Factory—Beckwith-Chandler Co., M. Gregor, 201 Emmett St., Newark, N. J., awarded contract for the construction of a 3 story, 80 x 100 ft. paint factory at 49-127 Ruthertford St., to Weston-Abbott Corp., 552 West 23rd St., New York, N. Y. Estimated cost \$75,000.

Paint Factory—E. J. Dupont de Nemours, Dupont Bldg., Wilmington, Del., will build a 2 story, 28 x 111.46 x 56 ft. paint factory at Grays Ferry Ave. and 35th St., Philadelphia, Pa. Estimated cost \$125,000. Private plans. Work will be done by separate contracts.

Paint Factory—J. T. Lewis & Bro., Widener Bldg., Philadelphia, Pa., awarded contract for a 1 story, 80 x 80 ft. paint factory at Aramingo and Cumberland Sts. to Turner Construction Co., 1700 Walnut St., Philadelphia.

Paint Factory—B. N. Nason & Co., 151 Potrero Ave., San Francisco, Calif., awarded contract for the construction of a 6 story, 100 x 100 ft. paint factory on Utah St. to G. Wagner, 181 South Park St., San Francisco. Estimated cost \$175,000.

Varnish Factory—McCloskey Varnish Co., 30th and Locust Sts., Philadelphia, Pa., awarded contract for a 1 and 2 story, 82 x 229 ft. factory and warehouse at State Rd. and Rhawn St. to F. V. Warren Co., 1913 Arch St., Philadelphia.

Paper Plant—Robert Gair Co., 420 Lexington Ave., New York, N. Y., will receive bids late in February for the construction of a 3 story warehouse, etc. in connection with paper plant at Piermont. Estimated cost \$250,000 to \$500,000. W. Higginson, 101 Park Ave., New York, is architect.

Paper Factory—H. F. Watson Paper Co., G. Coney, 143 East 16th St., Erie, Pa., subsidiary of The Rubberite Co., 95 Madison Ave., New York, N. Y., plans the construction of a paper factory on Holland St., Erie. Estimated cost \$200,000. Engineer not selected.

Paper Factory—Pacific Mills, Ltd., 510 Hastings St. W., Vancouver, B. C., is having plans prepared for the construction of a 2 story, 120 x 260 ft. factory for the manufacture of waxed coverings, wrappers, fruit papers, towels, and other specialties at ft. Campbell Ave. and Burwood Inlet. Estimated cost \$150,000. Private plans. Some new equipment will be required.

Paper Mill—Pacific Paper Products Co., A. A. Rogers, Pres., Eugene, Ore., will build a 1 story paper mill. Estimated cost \$500,000. Pulp and paper machinery, engines, dynamos, etc. will be required. P. J. Lamoureux, in charge.

Pottery Plant—Cowan Potteries, Inc., Rock River, O., plans the construction of a 1 story factory including equipment to increase capacity. Estimated cost \$50,000. Private plans.

Pottery Plant—Trenton Potteries Co., Clinton and Ott Sts., Trenton, N. J., will soon award contract for the construction of a 5 story pottery plant. Estimated cost to exceed \$40,000. Lockwood Greene & Co., 100 East 42nd St., New York, N. Y., are engineers.

Refinery—Magnolia Petroleum Co., Magnolia Bldg., Dallas, Tex., plans the construction of a refinery at Sweetwater. Estimated cost \$4,000,000. Private plans. Some work done by owners forces and some equipment will be required.

Refinery (Oil)—Addition—Pasotex Petroleum Co., El Paso, Tex., has work under way on addition to oil refinery at Womble Blvd. Estimated cost \$1,250,000. Private plans.

Refinery (Oil)—Standard Oil Co. of Pennsylvania, Peoples Gas Bldg., Pittsburgh, awarded contract for the construction of an oil refinery to include laboratory, pump stations, bulk station, etc. at Midland to Nicola Building Co., 6388 Penn Ave., Pittsburgh, Pa. Contract for tanks to Riter Conley Mfg. Co., Oliver Bldg., Pittsburgh.

Refinery (Oil)—Sun Oil Co. Ltd., 25 Atlantic Ave., Toronto, Ont., will soon award contract for a warehouse and other buildings in connection with oil refinery. Estimated cost \$200,000. Private plans.

Rolling Mill Plant, and Electric Furnace—McIntosh Hemphill Co., 12th and Etna Sts., Pittsburgh, Pa., manufacturers of rolling mill equipment and other heavy machinery, plans extensions and improvements to plant, also installation of an electric furnace and other equipment at Midland. Estimated cost \$85,000.

Roofing Products Factory—Barrett Co., 36th St. and Grays Ferry Ave., Philadelphia, Pa., manufacturers of roofing products is receiving bids for factory recently destroyed by fire. Estimated cost to exceed \$100,000. Private plans.

Rubber Factory—Tuscan Rubber Co., H. Richards, Pres., Carrollton, O., is having plans prepared for the construction of a 40 x 180 ft. rubber factory, two units. Estimated cost \$100,000. Private plans. Tire manufacturing equipment will be required.

Rubber Factory—Goodrich Rubber Co., 5400 East Ninth St., Los Angeles, Calif., is having plans prepared for a 1 story, 51 x 250 ft. addition to tire and rubber factory at 5400 East 9th St. Estimated cost \$150,000. Private plans.

Soap Factory—Akron Soap Co., Cuyahoga St., Akron, O., plans the construction of a 1 story factory at Cuyahoga Falls. Estimated cost \$40,000. New machinery and equipment, refrigerating units, etc. will be required.

Soap Factory—Procter & Gamble, 300 Avery St., Los Angeles, Calif., is having plans prepared for the construction of two factory buildings, 100 x 700 and 100 x 500 ft. also 500 ft. wharf and 14 steel storage tanks at Long Beach. Estimated cost \$5,000,000. Stone & Webster, Laughlin Bldg., Los Angeles, are engineers.

Soap and Perfume Products Plant—Pine Tree Products Co., B. B. Van, Pres., Newport, N. H., plans the construction of a plant for the manufacture of soap and toilet preparations. Estimated cost to exceed \$25,000. Private plans.

Factory—Yardleys Ltd., 358 Adelaide St. W., Toronto, Ont., awarded contract for the construction of a 77 x 101 ft. factory for the manufacture of toilet preparations to Jonckheere Construction Co., 1207 Bay St., Toronto. Estimated cost \$250,000.

Smelter and Refinery—American Smelting & Refining Co., 120 Broadway, New York, N. Y., is having tentative plans made for extensions and improvements to plant including new machinery for handling minerals and metallurgy of ores and metals; new crushing machinery and equipment; improvements to sampling mill; installing Dross reverberatory furnace and Sinter crushing plant, etc. at El Paso, Tex. Estimated cost \$100,000. Private plans.

Welding Plant—Beard Corp., c/o J. B. Beard, Shreveport, La., will build a welding plant. Estimated cost \$250,000. Work will be done by local labor.

Tile Factory—American Tile Co., Indianapolis, Ind., awarded contract for the construction of a 60 x 144 ft. factory at 1042 East Washington St. to A. Bertels, 1521 North La Salle St., Indianapolis. Estimated cost \$44,000.

Technical Societies, Trade Associations, And Commercial Organizations



AGRICULTURAL, Insecticide & Fungicide Manufacturers Assn. Sec., G. B. Heckel, 1004 Public Ledger Bldg., Philadelphia, Pa.

Amer. Assn. for the Advancement of Science. Permanent Sec., Dr. Burton E. Livingston, Smithsonian Inst. Bldg., Washington, D. C.

Amer. Assn. of Cereal Chemists. Sec.-Treas., M. D. Mize, 836 Omaha Grain Exchange, Omaha, Neb.

Amer. Assn. of Engrs. Sec., M. E. McIver, 8 South Michigan Blvd., Chicago, Ill.

Amer. Assn. of Flint and Lime Glass Mfrs. Actuary, John Kunzler, House Bldg., Pittsburgh, Pa.

Amer. Assn. of Textile Chemists & Colorists. Sec., Alex. Morrison, c/o American Woolen Co., Shawsheen Village, Andover, Mass.

Amer. Bakers' Assn. Sec., Tom Smith, 1135 Fullerton Ave., Chicago, Ill.

Amer. Ceramic Society. General Sec., Ross C. Purdy, Lord Hall, 2525 N. High St., Columbus, Ohio.

Amer. Chemical Society. Sec., Dr. Charles L. Parsons, Mills Bldg., Washington, D. C.

Amer. Concrete Institute. Sec., Harvey Whipple, 2970 W. Grand Blvd., Detroit, Mich.

Amer. Electrochemical Soc. Sec., Dr. C. G. Fink, Columbia Univ., New York.

Amer. Electro-Platers' Soc. Sec., Geo. Gehling, 5001 Edmund St., Philadelphia, Pa.

Amer. Engineering Council. Executive Sec., L. W. Wallace, 26 Jackson Pl., Washington, D. C.

Amer. Foundrymen's Assn. Executive Sec.-Treas., C. E. Hoyt, 222 West Adams St., Chicago, Ill.

Amer. Gas Assn. Managing Director, Alexander Forward, 420 Lexington Ave., New York.

Amer. Gear Manufacturers Assn. Sec., T. W. Owen, 3608 Euclid Ave., Cleveland, Ohio.

Amer. Inst. of Baking. C. B. Morison, Dean, 1135 Fullerton Ave., Chicago, Ill.

Amer. Inst. of Chemical Engrs. Sec., H. C. Parmelee, Tenth Ave. at 36th St., New York, N. Y.

Amer. Inst. of Chemists. Sec., Howard S. Neiman, 2110 Woolworth Bldg., New York.

Amer. Inst. of Consulting Engrs. Sec. and Treas., Phillip W. Henry, 75 West St., New York.

Amer. Inst. of Electrical Engrs. National Sec., F. L. Hutchinson, 33 W. 39th St., New York.

Amer. Inst. of Fertilizer Chemists. Sec.-Treas., W. J. Gascoyne, Jr., 27 S. Gay St., Baltimore, Md.

Amer. Inst. of Mining & Metallurgical Engrs. Sec., H. Foster Bain, 29 W. 39th St., New York.

Amer. Inst. of Refrigeration. Gen. Sec., J. F. Nickerson, 5707 West Lake St., Chicago, Ill.

Amer. Iron & Steel Institute. Sec., E. A. S. Clarke, 75 West St., New York.

Amer. Leather Chemists Assn. Sec., H. C. Reed, 143 West 20th St., New York.

Amer. Management Assn. Managing Director, W. J. Donald, 20 Vesey St., New York.

Amer. Manganese Producers Assn. Sec., Harold A. Pumpelly, Metropolitan Bank Bldg., Washington, D. C.

Amer. Manufacturers' Export Assn. Sec., R. G. Owens, 233 Broadway, New York.

Amer. Museum of Safety. Director, Albert A. Hopkins, Office, 141 E. 29th St.; Museum, 120 E. 28th St., New York.

American Oil Burner Assn. Executive Sec., Harry F. Tapp, 342 Madison Ave., New York.

Amer. Oil Chemists' Society. Sec., J. C. P. Helm, 705 Tchoupitoulas St., New Orleans, La.

American Paint & Varnish Manufacturers' Assn., Inc. Sec., G. B. Heckel, 1002-4 Public Ledger Bldg., Philadelphia, Pa.; Gen. Mgr., George V. Horgan, 18 E. 41st St., New York; Director of Scientific Section, H. A. Gardner, 2201 New York Ave., N. W., Washington, D. C.

Amer. Paper & Pulp Assn. Acting Sec., Charles W. Boyce, 18 East 41st St., New York.

Amer. Peat Soc. Acting Sec., J. H. Beattie, McLean, Va.

Amer. Petroleum Inst. Sec., Lacey Walker, 250 Park Ave., New York.

Amer. Physical Soc. Sec., W. L. Severinghaus, Columbia Univ., New York.

This compilation of technical and commercial organizations in the chemical engineering and related fields should prove valuable as a reference directory. An effort has been made in each case to give the name and address of the secretary or other responsible official. Additions or corrections should be sent to the Editor, *Chemical & Metallurgical Engineering*, Tenth Ave. at 36th St., New York City.

Amer. Pulp & Paper Mill Superintendents Assn. Sec., R. L. Eminger, 54 N. Main St., Miamisburg, Ohio.

American Refractories Institute. Sec., Dorothy A. Texter, 2218 Oliver Bldg., Pittsburgh, Pa.

Amer. Society of Bakery Engrs. Sec., Victor E. Marx, 1541 Birchwood Ave., Chicago, Ill.

Amer. Society of Civil Engrs. Sec., George T. Seabury, 33 W. 39th St., New York.

Amer. Soc. of Heating & Ventilating Engrs. Sec., A. V. Hutchinson, 29 W. 39th St., New York.

Amer. Soc. of Mechanical Engrs. Sec., Calvin W. Rice, 29 W. 39th St., New York.

Amer. Soc. of Refrigerating Engrs. Sec., David L. Fiske, 37 West 39th St., New York.

Amer. Soc. of Safety Engrs. Sec., W. D. Keefer, 108 E. Ohio St., Chicago, Ill.

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